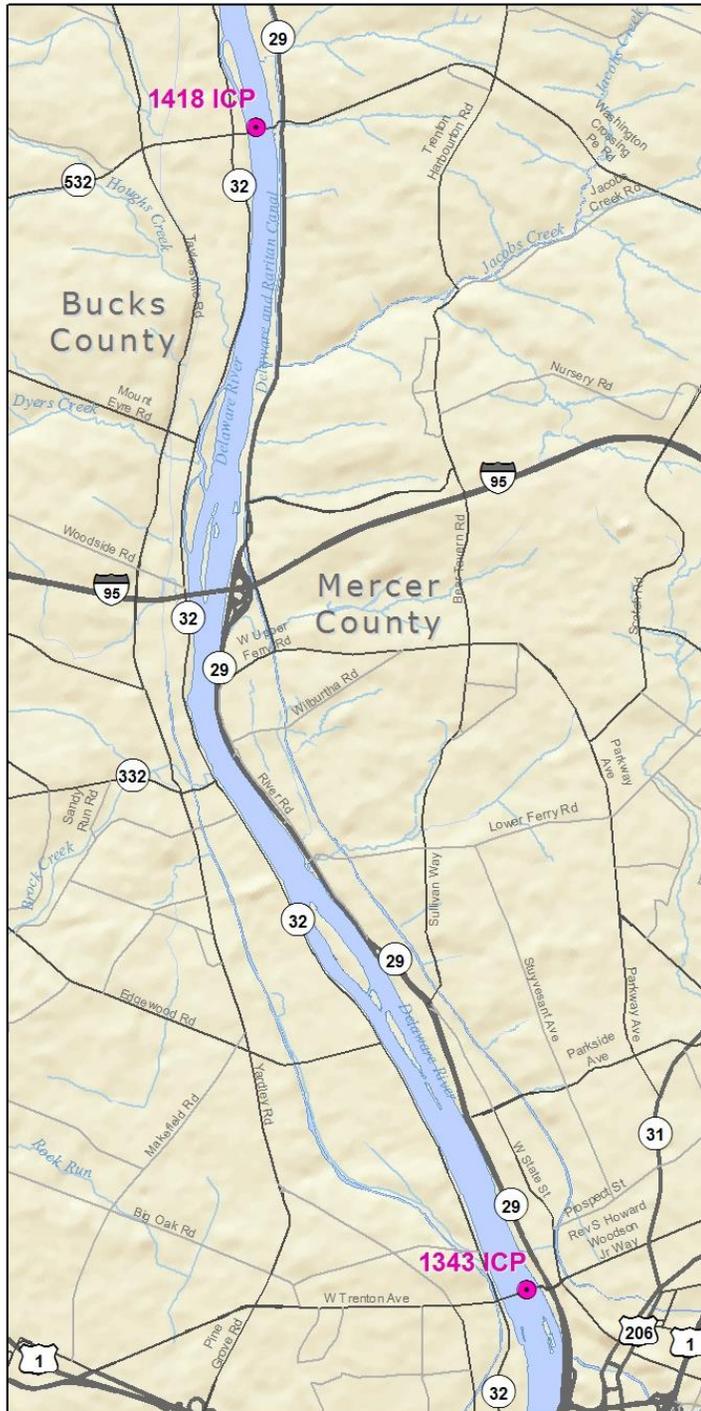


# Chapter 1: 1343 ICP Delaware River at Trenton/Morrisville, NJ/PA



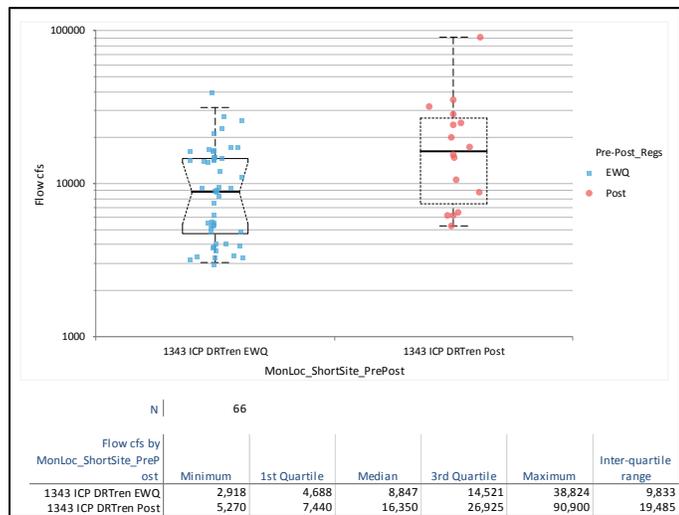
**1343 ICP**  
Delaware River at Calhoun Street Bridge, Trenton



- Sampling Location
- - - County Boundary



Analysis of flow differences between the EWQ and post-EWQ monitoring periods:



Kruskal-Wallis test

Flow cfs by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	50	729.6	14.59
1343 ICP DRTren Post	16	2280.1	142.50

H statistic	8.17
X <sup>2</sup> approximation	8.17
DF	1
p-value	0.0043 <sup>1</sup>

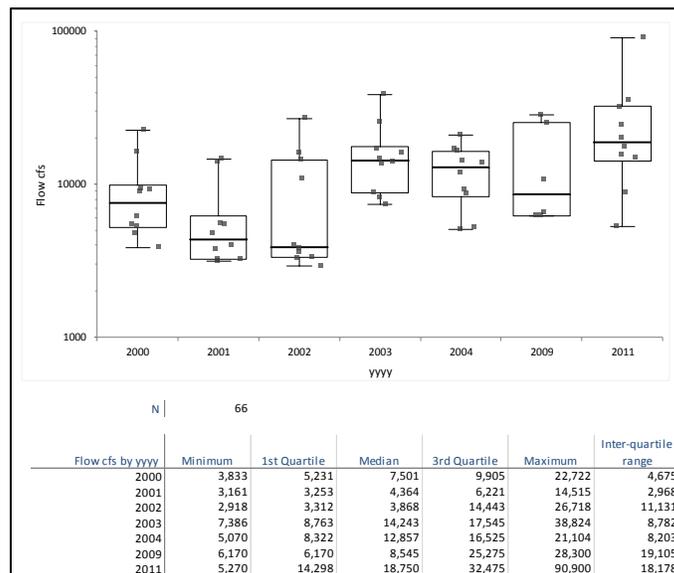
H<sub>0</sub>: θ<sub>1</sub> = θ<sub>2</sub> = θ...  
 The median of the populations are all equal.  
 H<sub>1</sub>: θ<sub>i</sub> ≠ θ<sub>j</sub> for at least one i,j  
 The median of the populations are not all equal.  
<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

Flow was higher in the post-EWQ period at this location. EWQ flow was slightly below normal for the May to September period and post-EWQ flow was generally above-normal. For flow-related parameters, this difference can lead to misinterpretation of results, so comparisons are carefully reviewed, especially in cases where statistical differences are significant. Flow is plotted on a logarithmic scale.

Upstream ICP: Del. River at Washington Crossing  
 Downstream ICP: None. This is the southern terminus of the DRBC Special Protection Waters region. At the geological fall line just below Calhoun Street Bridge, is the freshwater tidal portion of the Delaware River (DRBC Water Quality Zone 2).

Tributary BCP Watersheds in Upstream Reach:

None. All tributaries are less than 20 square miles drainage area and are expected to exert minimal water quality influence upon the Delaware River. These small tributaries are infrequently monitored.



Annual flow statistics are plotted above. Note that no samples were taken in the dry 2010 season due to closure of the Calhoun Street Bridge. This is why post-EWQ data were not representative of flow conditions. Post-EWQ data were also insufficient in the number of samples taken (n=16), which also reduces overall confidence in statistical comparisons between the two periods. Flow statistics are derived from May to September flow measurements associated with the time of each water quality sample. Flow is based on the USGS gage 01463500 at Trenton, NJ. “Normal” May to September flow is about 10,000 cfs at this location on the Delaware River.

Within the data, annual summer flow is below normal to normal for 4 years and above normal for 3 years. When examining annual summer flow water quality statistics between the EWQ and post-EWQ periods, post-EWQ water quality is likely most comparable to EWQ 2003-2004 data when flow was above normal.

This location is also monitored by NJDEP (USGS) and PADEP. Those data are not included in DRBC’s analyses, but were held back as confirmatory data for significant results found by DRBC. The state/USGS programs generally monitor quarterly for long-term water quality changes. DRBC’s monitoring design is more intensive and less long-term, taking 5 to 10 samples each May-September season depending on the sampling location.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

Alkalinity as CaCO<sub>3</sub>, Total mg/l

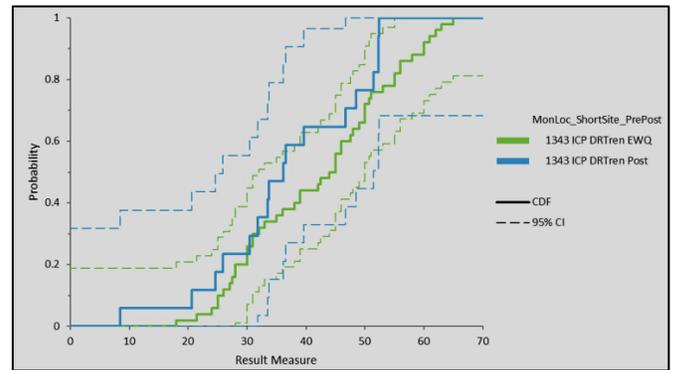
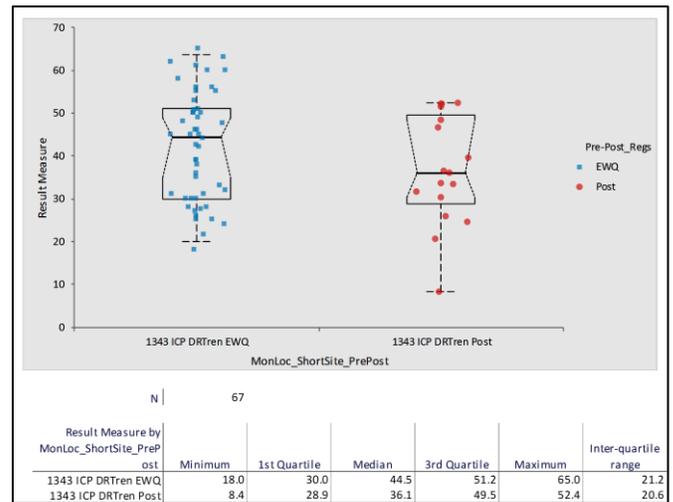
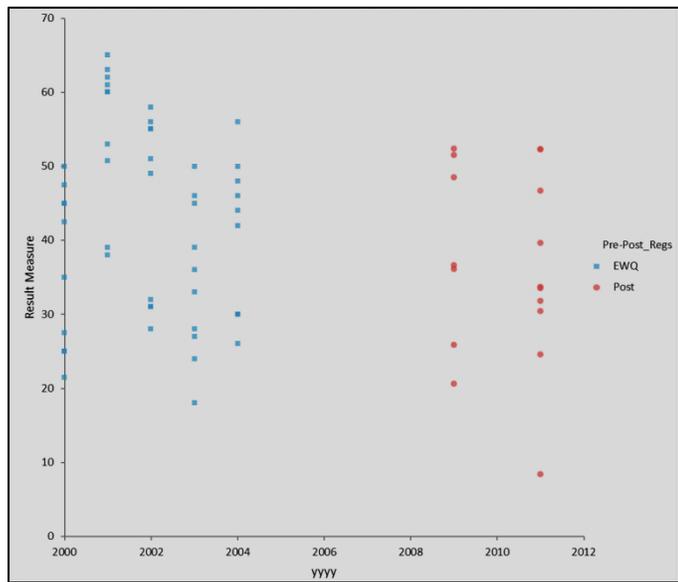
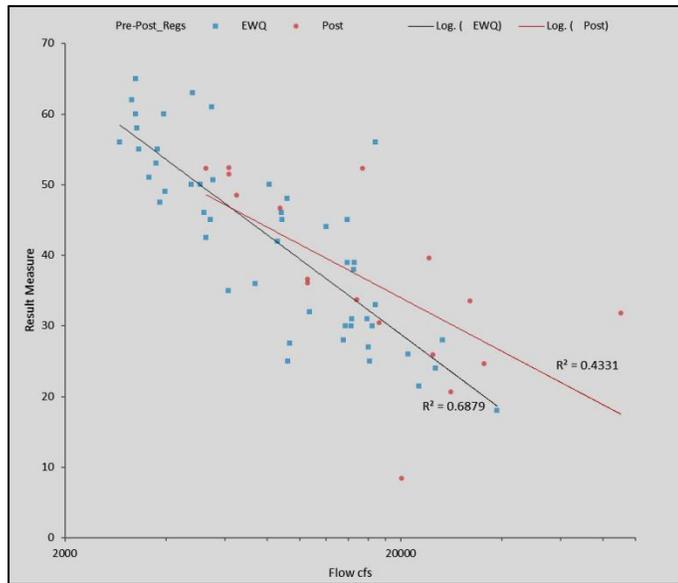
Existing Water Quality:

Median 45 mg/l

Lower 95% Confidence Interval 36 mg/l

Upper 95% Confidence Interval 50 mg/l

Defined in regulations as a flow-related parameter



Kruskal-Wallis test

MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	50	128.0	2.56
1343 ICP DRTren Post	17	376.5	22.15

H statistic: 1.33  
 $\chi^2$  approximation: 1.33  
 DF: 1  
 p-value: 0.2489<sup>1</sup>

H<sub>0</sub>:  $\theta_1 = \theta_2 = \theta_3 \dots$   
 The median of the populations are all equal.  
 H<sub>1</sub>:  $\theta_i \neq \theta_j$  for at least one i, j  
 The median of the populations are not all equal.

<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is indicated. Alkalinity concentrations appear to decline between the EWQ and post-EWQ periods, but the post-EWQ samples were taken under generally higher flow conditions and do not differ statistically. However, potential laboratory artifacts and insufficient post-EWQ sampling (n=17) introduced analytical uncertainty. Alkalinity is inversely related to flow. No 2010 samples were taken at this site due to bridge closure. As 2010 was a dry year, such dry-weather samples are under-represented in the post-EWQ data set. Note that flow is plotted on a logarithmic scale.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

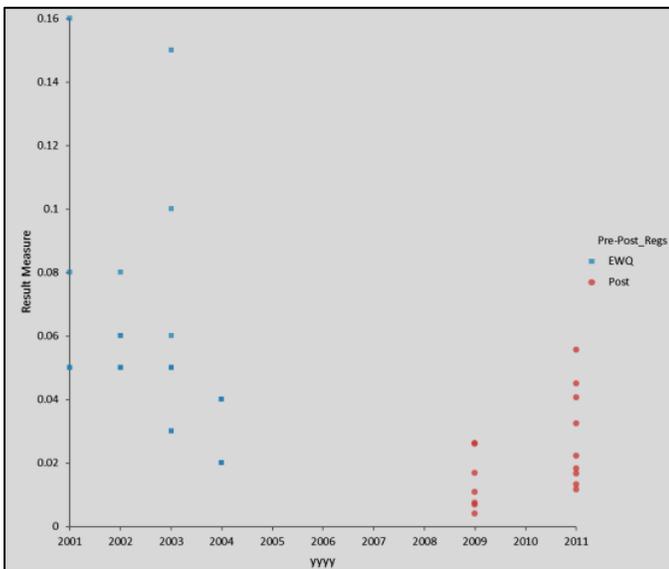
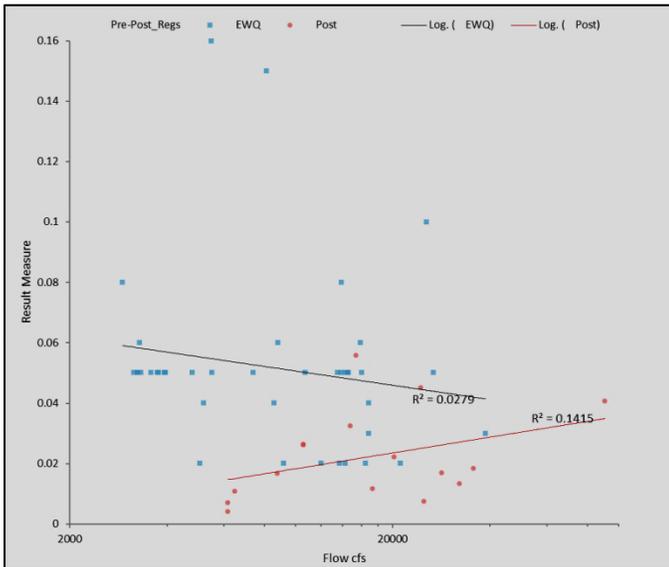
Ammonia Nitrogen as N, Total mg/l

Existing Water Quality:

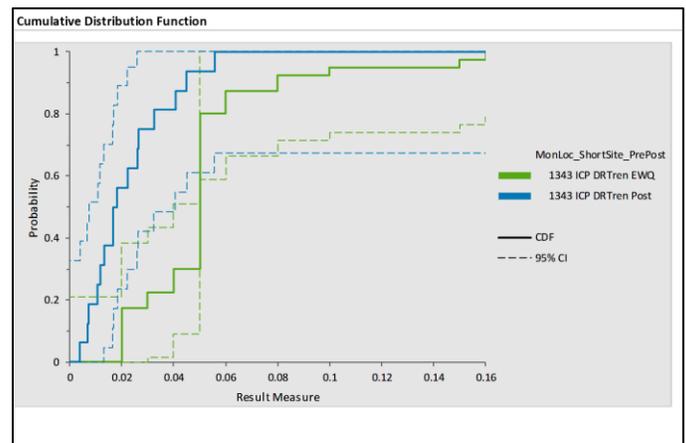
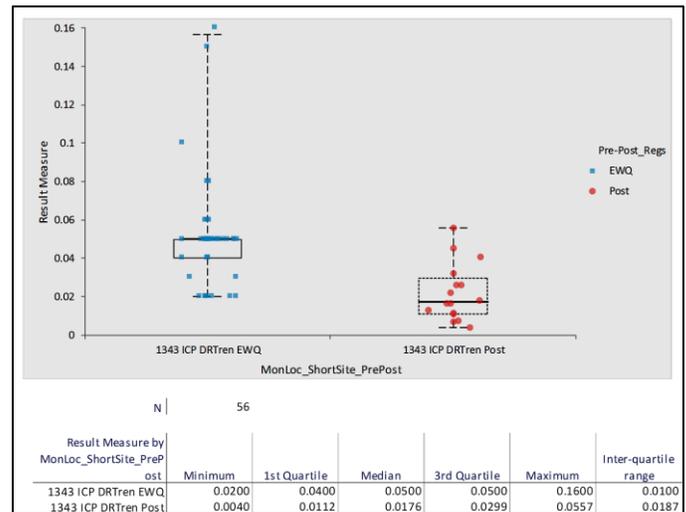
Median <0.05 mg/l

Lower 95% Confidence Interval <0.05 mg/l

Upper 95% Confidence Interval <0.05 mg/l



No water quality degradation is indicated. Ammonia concentrations appeared to decline, though detection limit differences, flow differences, insufficient post-EWQ sampling (n=16) and potential laboratory artifacts produced analytical uncertainty. No 2010 samples were taken at this site due to bridge closure.



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	ost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ		40	1368.9	34.22
1343 ICP DRTren Post		16	3422.3	213.89

H statistic	18.91
X <sup>2</sup> approximation	18.91
DF	1
p-value	<0.0001 <sup>1</sup>

H0:  $\theta_1 = \theta_2 = \dots$   
 The median of the populations are all equal.  
 H1:  $\theta_i \neq \theta_j$  for at least one i,j  
 The median of the populations are not all equal.

<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

Ammonia is unrelated to flow in both data sets. No declining trend was found in independent USGS, PADEP or NJDEP data. EWQ data contained 29/40 undetected results that interfered with estimates of the median and its confidence intervals. Thus all we could determine about ammonia was that concentrations were known to be <0.05 mg/l. There were no undetected results in the post-EWQ samples. However, some water quality improvement might have occurred, in that there were no post-EWQ values over 0.056 mg/l.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

Chloride, Total mg/l

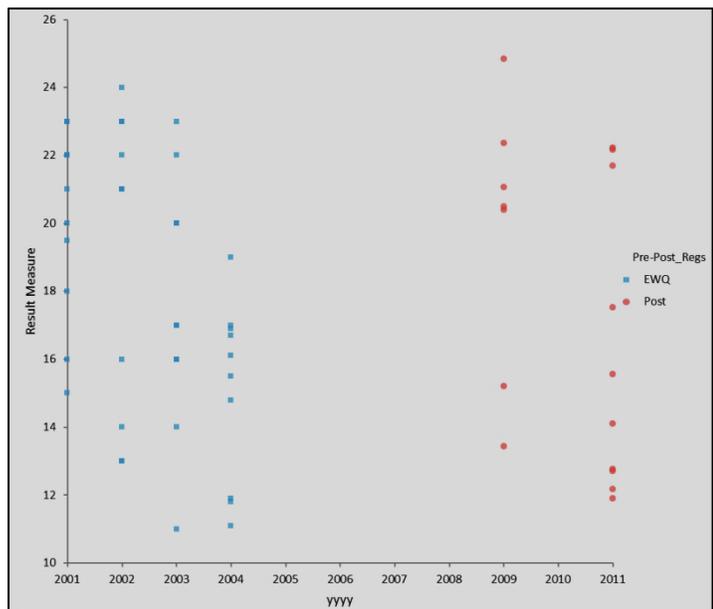
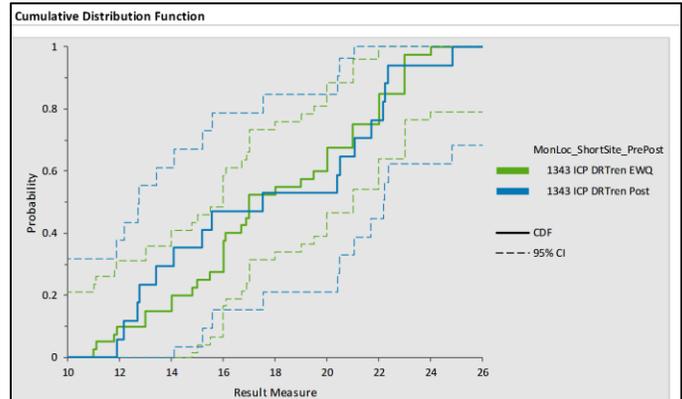
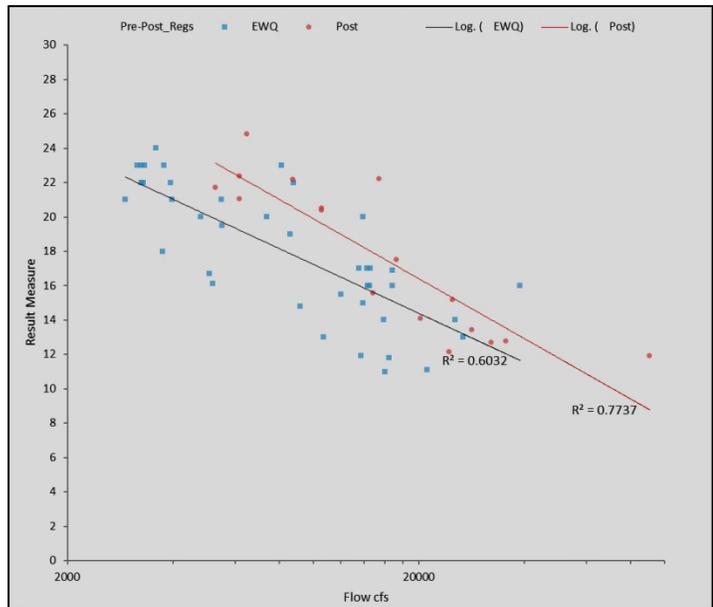
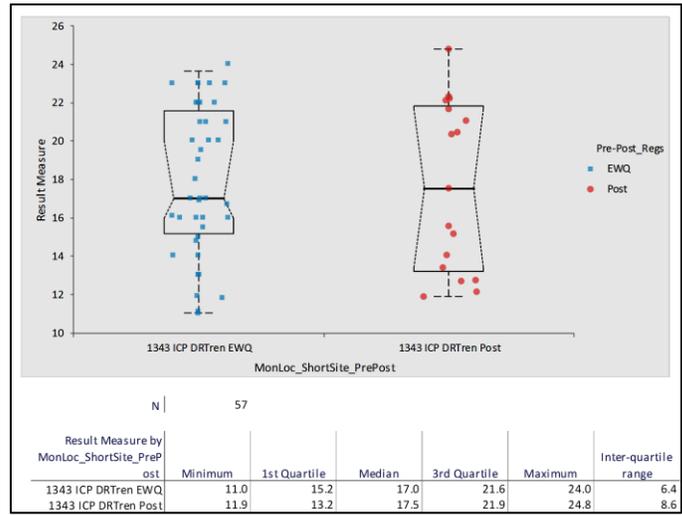
Existing Water Quality:

Median 17 mg/l

Lower 95% Confidence Interval 16 mg/l

Upper 95% Confidence Interval 21 mg/l

Defined in regulations as a flow-related parameter



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	40	3.6	0.09
1343 ICP DRTren Post	17	8.5	0.50

H statistic: 0.04  
 $\chi^2$  approximation: 0.04  
 DF: 1  
 p-value: 0.8341<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \dots$   
 The median of the populations are all equal.  
 H1:  $\theta_i \neq \theta_j$  for at least one i,j  
 The median of the populations are not all equal.

<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

Some evidence of water quality degradation is indicated, though chloride concentrations apparently did not change between the two periods. Flow differences, insufficient post-EWQ sampling (n=16) and potential laboratory artifacts produced analytical uncertainty. Chloride is inversely related to flow. No 2010 samples were taken due to bridge closure. If more post-EWQ samples were taken, and if post-EWQ data were more representative of low-flow conditions, there might have been a significant rise in chlorides. On the first graph of concentrations vs. flow, the rise in concentrations appears to be approximately 1 to 3 mg/l.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

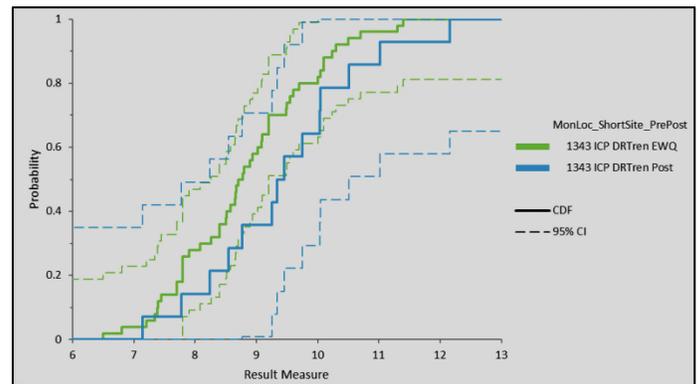
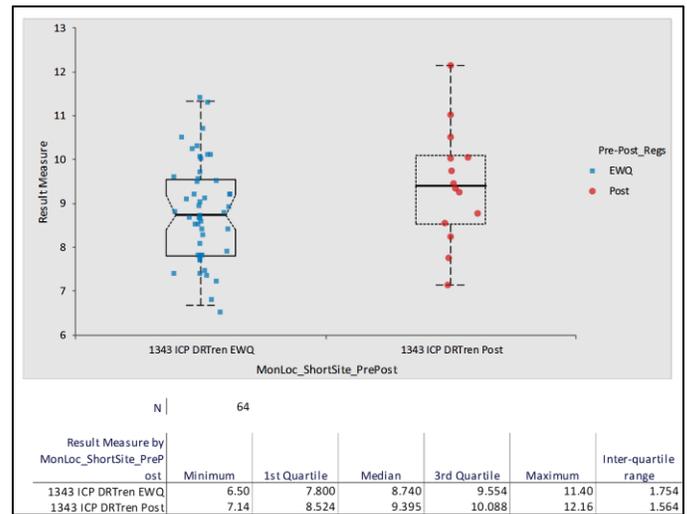
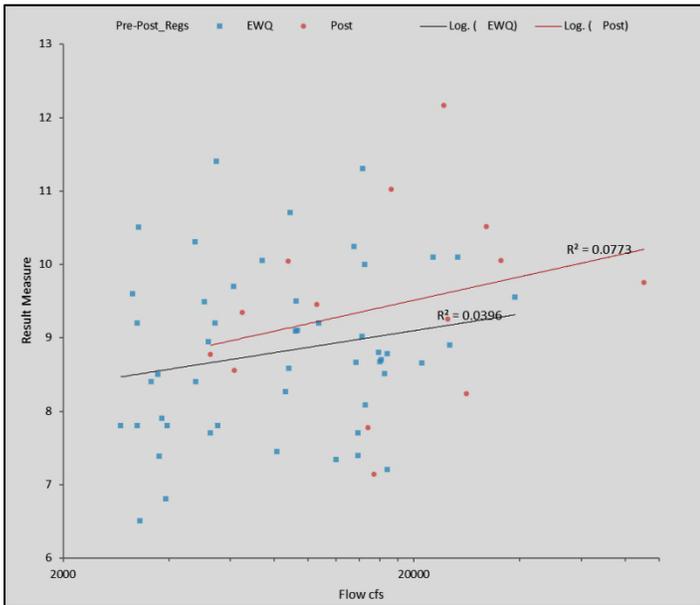
Dissolved Oxygen (DO) mg/l

Existing Water Quality:

Median 8.74 mg/l

Lower 95% Confidence Interval 8.40 mg/l

Upper 95% Confidence Interval 9.20 mg/l

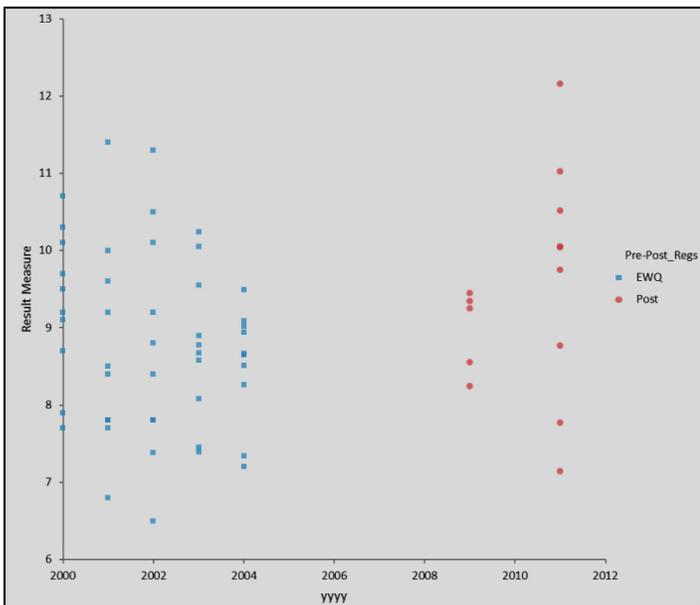


Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	50	174.8	3.50
1343 ICP DRTren Post	14	624.4	44.60

H statistic: 2.31  
 $\chi^2$  approximation: 2.31  
 DF: 1  
 p-value: 0.1288<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3 \dots$   
 The median of the populations are all equal.  
 H1:  $\theta_i \neq \theta_j$  for at least one i,j.  
 The median of the populations are not all equal.  
<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.



Dissolved Oxygen (DO) concentration is unrelated to flow. No measurable change took place between the EWQ and Post-EWQ periods. Median post-EWQ DO concentration was above the EWQ upper 95% confidence interval, but there were an insufficient number of post-EWQ samples taken to detect a significant change. Such a change would constitute a water quality improvement in any case. No 2010 samples were taken due to bridge closure. Daily DO ranges widely at this location due to growth of aquatic plants and algae (primary production). Values shown best represent mid-day concentrations, when DO is typically at or near its maximum daily value.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

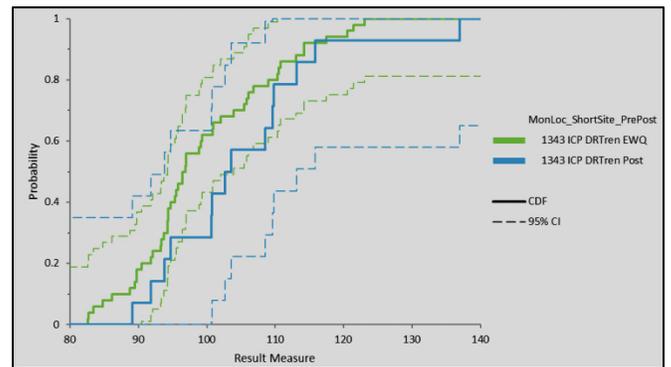
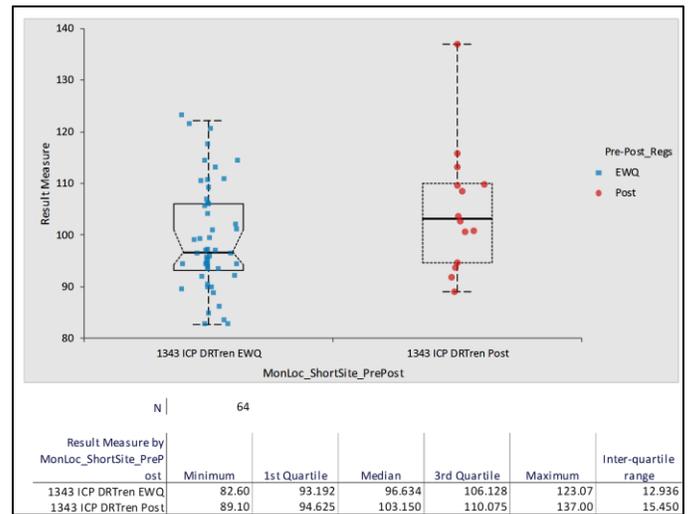
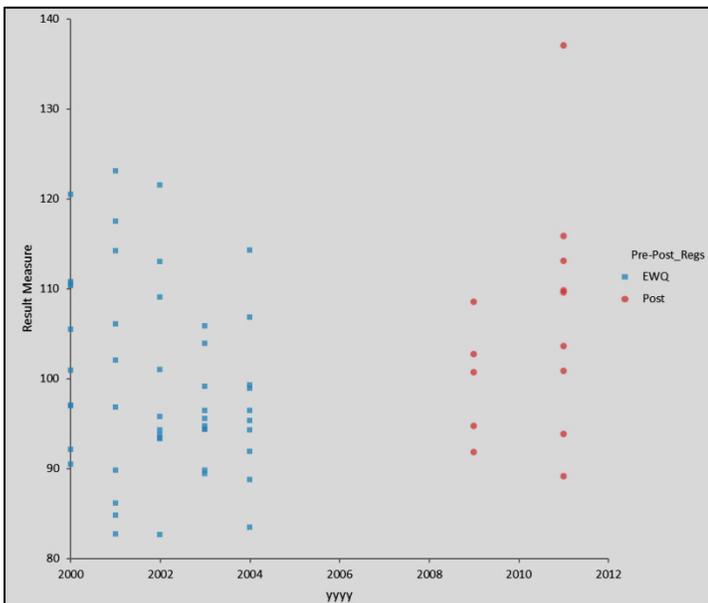
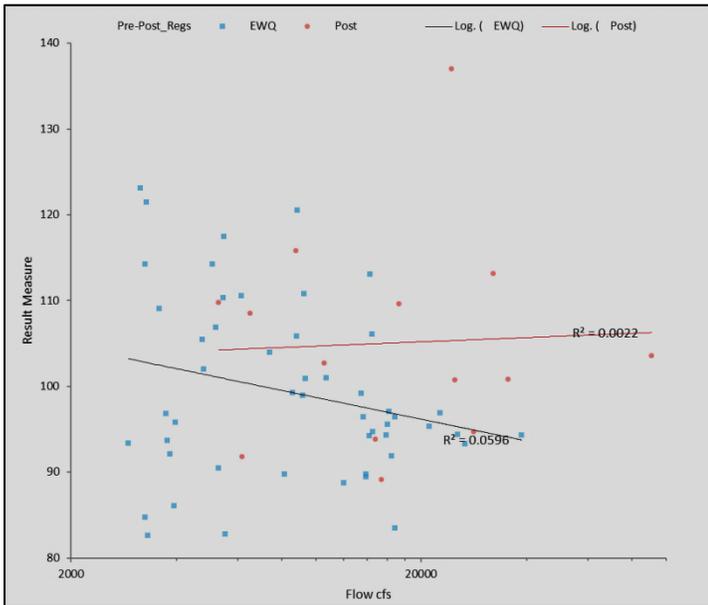
Dissolved Oxygen Saturation %

Existing Water Quality:

Median 97%

Lower 95% Confidence Interval 94%

Upper 95% Confidence Interval 101%



Kruskal-Wallis test

MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	50	158.4	3.17
1343 ICP DRTren Post	14	565.8	40.41

H statistic | 2.09  
 X² approximation | 2.09  
 DF | 1  
 p-value | 0.1484<sup>1</sup>  
 H0:  $\theta_1 = \theta_2 = \theta_3 = \dots$   
 The median of the populations are all equal.  
 H1:  $\theta_i \neq \theta_j$  for at least one i,j  
 The median of the populations are not all equal.  
<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

Dissolved Oxygen Saturation is unrelated to flow, and did not measurably change between the EWQ and post-EWQ periods. No 2010 samples were taken at this site due to bridge closure. As a rule-of-thumb, saturation values greater than 120% indicated super-saturation conditions, usually produced by very high algae and aquatic plant activity.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

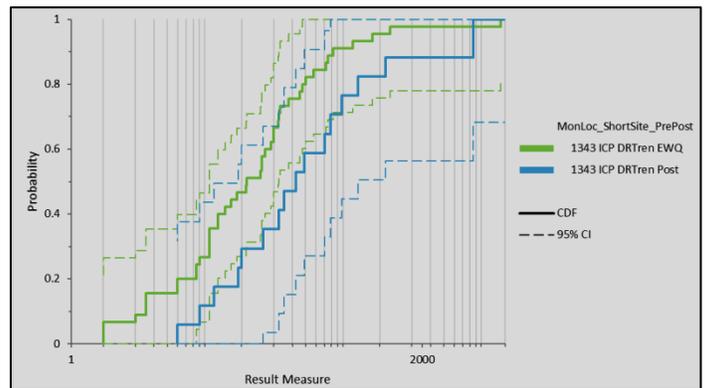
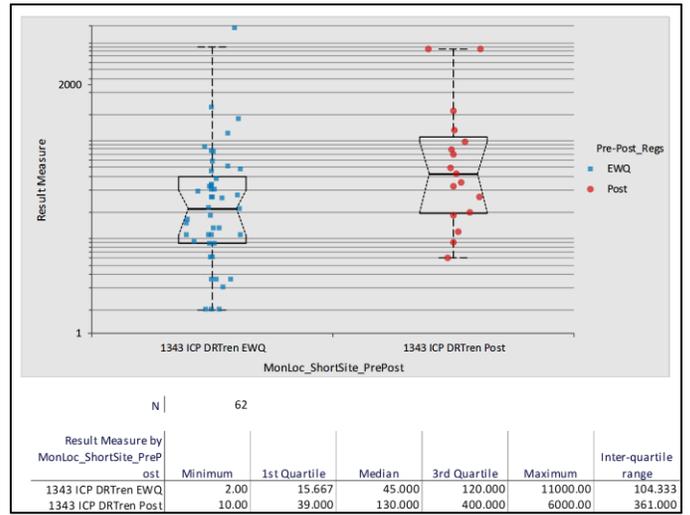
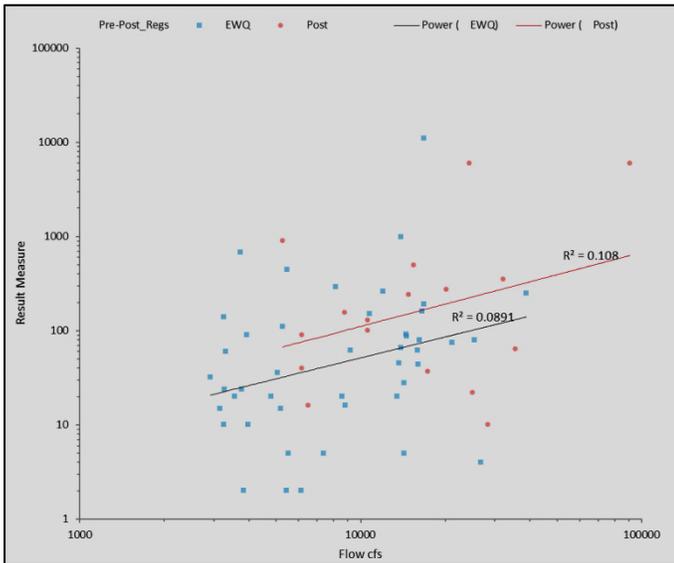
Enterococcus colonies/100 ml

Existing Water Quality:

Median 45/100 ml

Lower 95% Confidence Interval 20/100 ml

Upper 95% Confidence Interval 80/100 ml



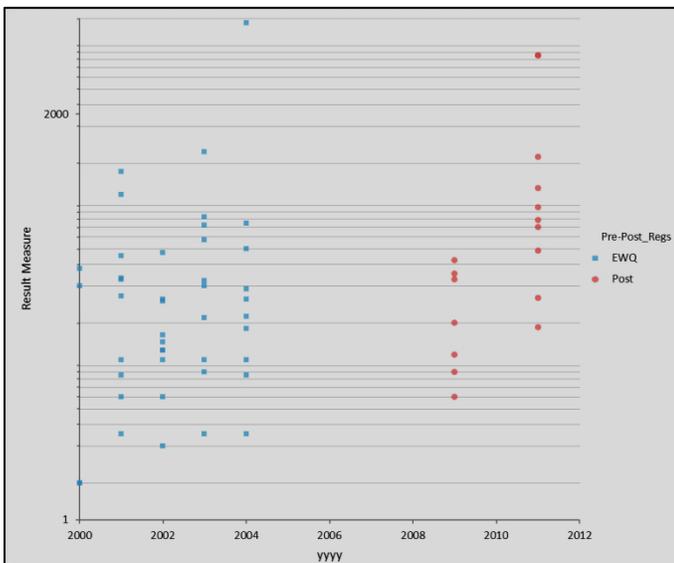
Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	45	483.5	10.74
1343 ICP DRTren Post	17	1279.8	75.28

H statistic: 5.42  
 X<sup>2</sup> approximation: 5.42  
 DF: 1  
 p-value: 0.0199<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta...$   
 The median of the populations are all equal.  
 H1:  $\theta_i \neq \theta_j$  for at least one i,j  
 The median of the populations are not all equal.

<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.



Enterococci apparently rose between the EWQ and Post-EWQ periods. Flow differences, insufficient post-EWQ sampling (n=17) and potential laboratory artifacts produced analytical uncertainty. No 2010 samples were available, as the bridge was closed that summer. Enterococcus concentration is unrelated to flow in both data sets. Note that concentrations are plotted on a logarithmic scale.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

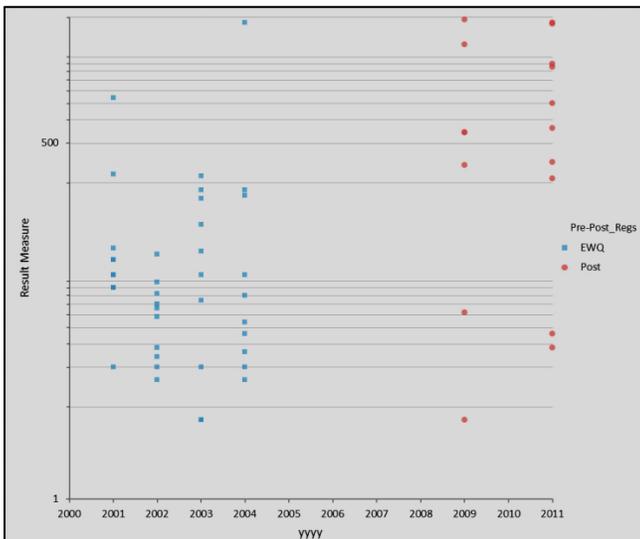
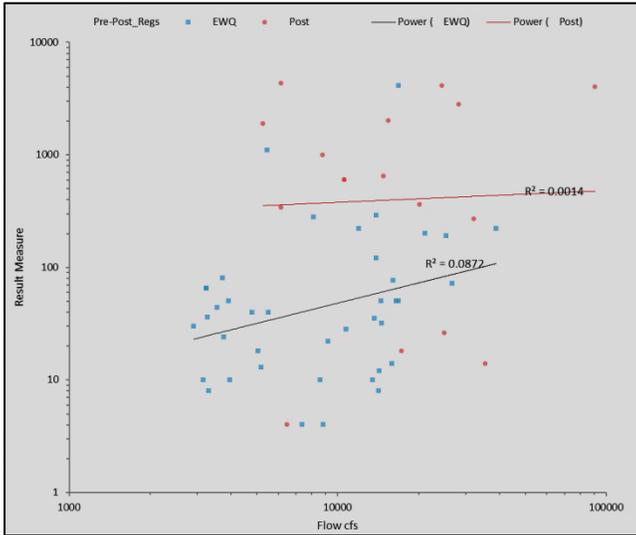
Escherichia coli colonies/100 ml

Existing Water Quality:

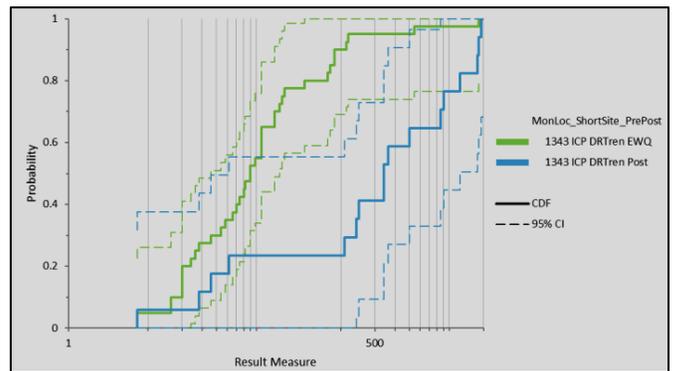
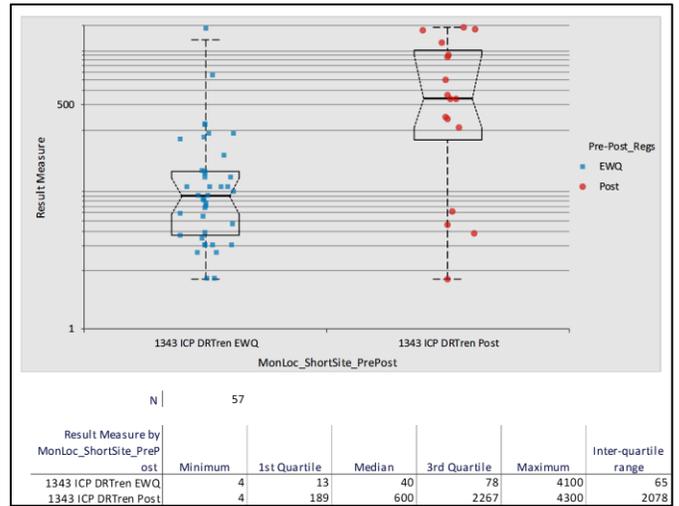
Median 40/100 ml

Lower 95% Confidence Interval 24/100 ml

Upper 95% Confidence Interval 65/100 ml



Some evidence of water quality degradation is indicated. E. coli concentrations apparently rose between the two periods. Flow differences, insufficient post-EWQ sampling (n=17) and potential laboratory artifacts produced analytical uncertainty. No 2010 dry-weather samples were available due to bridge closure.



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	40	965.3	24.13
1343 ICP DRTren Post	17	2271.3	133.61

H statistic | 11.76  
 X² approximation | 11.76  
 DF | 1  
 p-value | 0.0006<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \dots$   
 The median of the populations are all equal.  
 H1:  $\theta_i \neq \theta_j$  for at least one  $i, j$   
 The median of the populations are not all equal.

<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

Flow and concentrations are plotted on a logarithmic scale; regressions are power relationships. USGS, PADEP and NJDEP data were tested to confirm DRBC's result of significant rise in E. coli. Baseline EWQ concentrations were confirmed by independent data, establishing that DRBC's baseline is reasonable. However, the significant 2009-2011 increase found by DRBC was not confirmed by independent data. Confidence of an increase is low because of low N, high variability, and flow differences.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

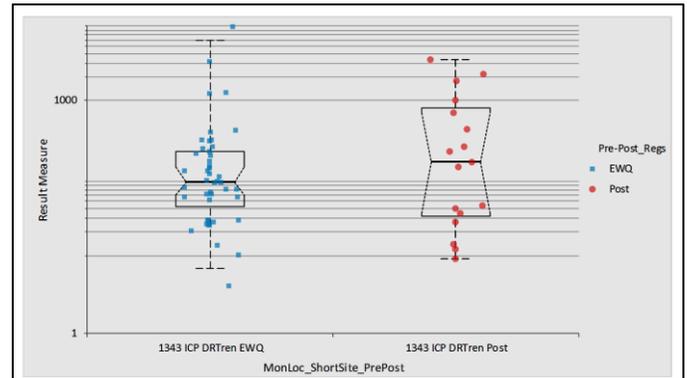
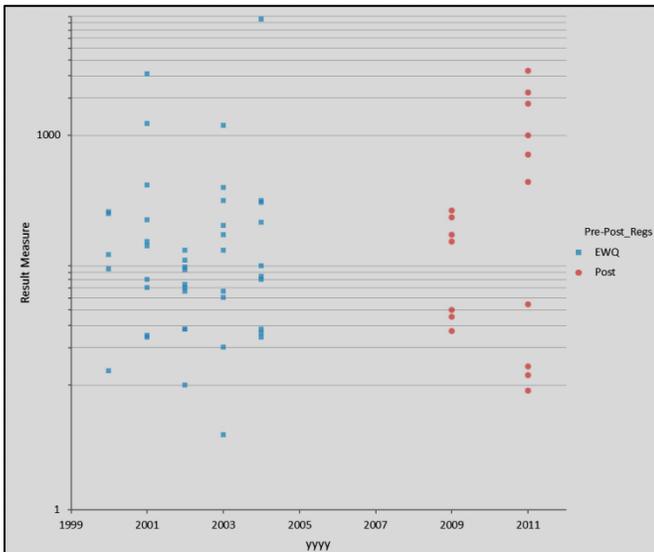
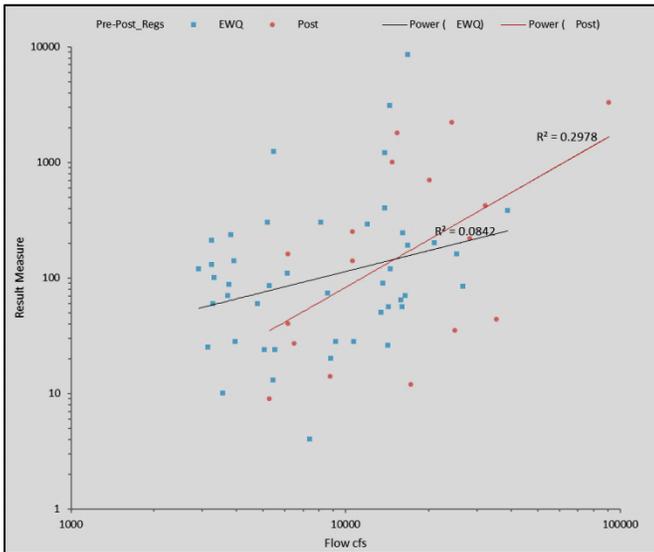
Fecal coliform colonies/100 ml

Existing Water Quality:

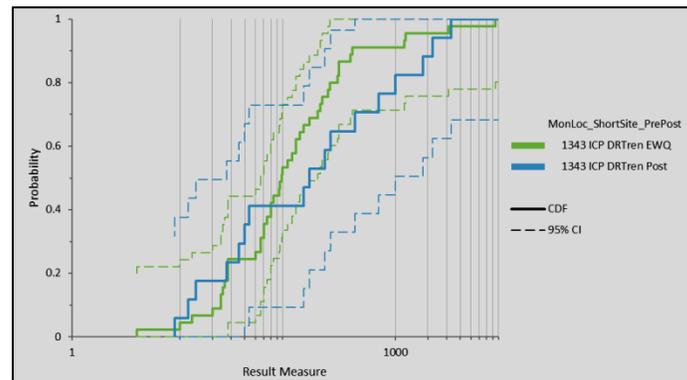
Median 88/100 ml

Lower 95% Confidence Interval 60/100 ml

Upper 95% Confidence Interval 140/100 ml



Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1343 ICP DRTren EWQ	4	43	88	218	8500	176
1343 ICP DRTren Post	9	32	160	800	3300	768



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	45	50.1	1.11
1343 ICP DRTren Post	17	132.7	7.81

H statistic: 0.56  
 X² approximation: 0.56  
 DF: 1  
 p-value: 0.4535<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3 = \dots$   
 The median of the populations are all equal.  
 H1:  $\theta_i \neq \theta_j$  for at least one i,j  
 The median of the populations are not all equal.

<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is indicated. Fecal coliform concentrations did not measurably change between the EWQ and post-EWQ periods. Flow differences, insufficient post-EWQ sampling (n=17) and potential laboratory artifacts produced analytical uncertainty. Post-EWQ fecal coliform concentrations are positively but weakly related to flow. No 2010 samples were collected due to bridge closure.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

Hardness as CaCO<sub>3</sub>, Total mg/l

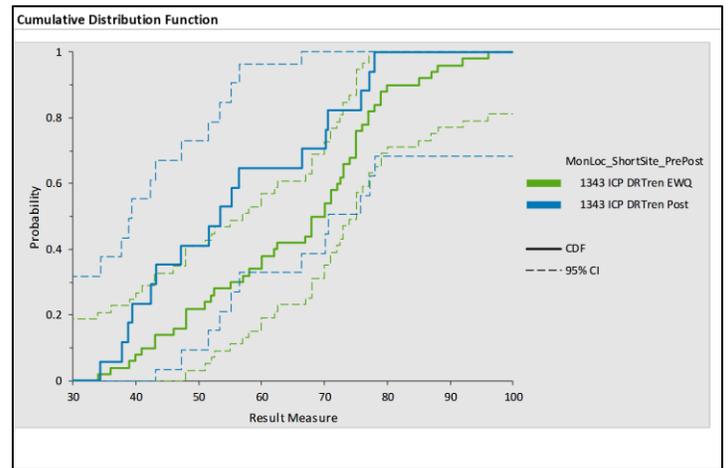
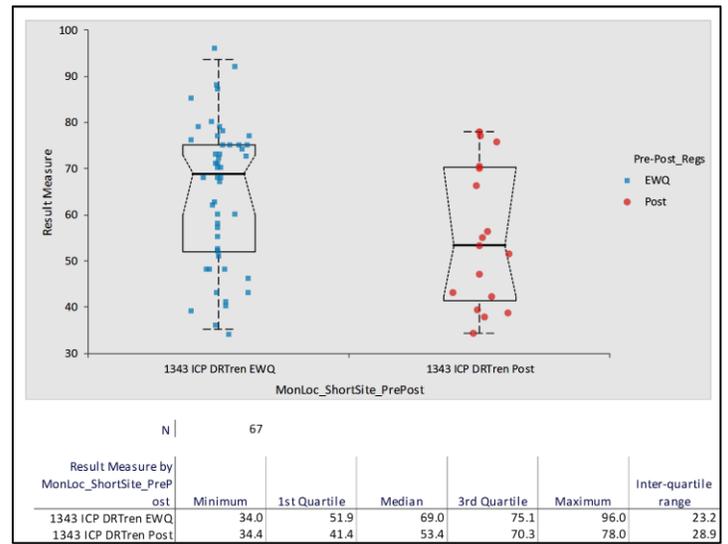
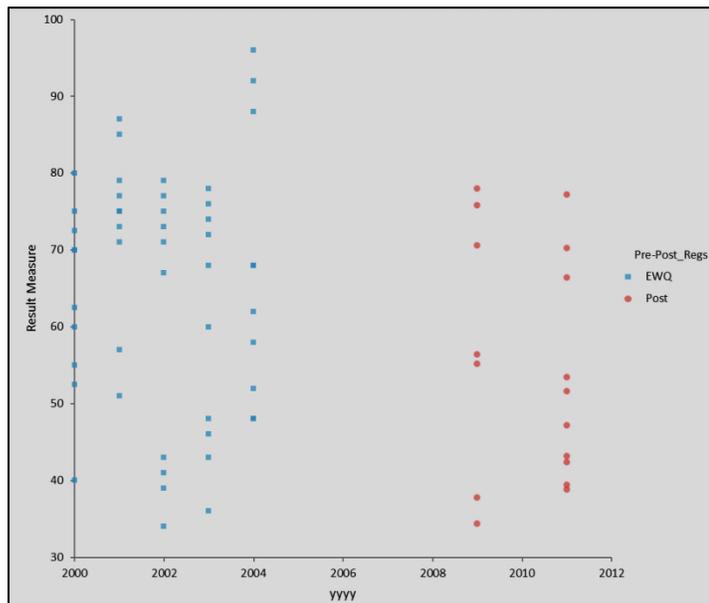
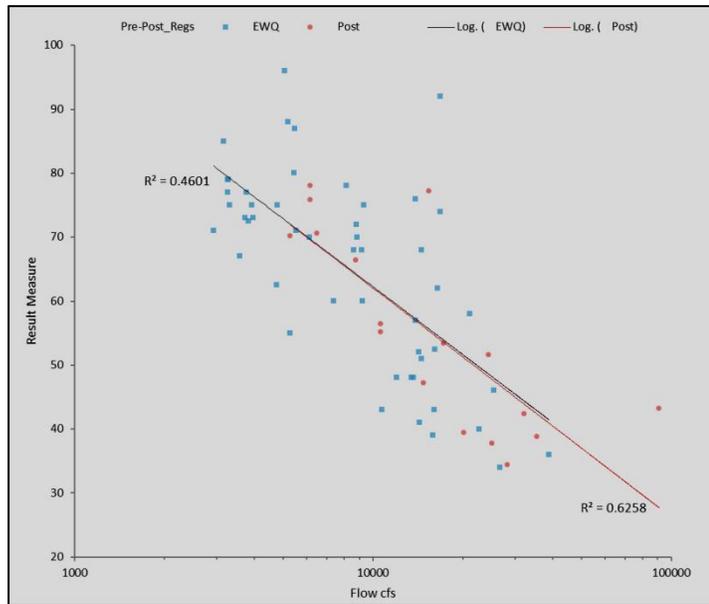
Existing Water Quality:

Median 69 mg/l

Lower 95% Confidence Interval 60 mg/l

Upper 95% Confidence Interval 73 mg/l

Defined in regulations as a flow-related parameter



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	50	423.4	8.47
1343 ICP DRTren Post	17	1245.3	73.25

H statistic | 4.40  
 X<sup>2</sup> approximation | 4.40  
 DF | 1  
 p-value | 0.0360<sup>1</sup>

H0: θ<sub>1</sub> = θ<sub>2</sub> = θ...

The median of the populations are all equal.

H1: θ<sub>i</sub> ≠ θ<sub>j</sub> for at least one i,j

The median of the populations are not all equal.

<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

No water quality degradation is indicated. Hardness appeared to decline between the EWQ and post-EWQ periods. Flow differences, insufficient post-EWQ sampling (n=17) and potential laboratory artifacts produced analytical uncertainty. Hardness is inversely related to flow. No 2010 samples were taken at this location due to bridge closure. If more post-EWQ samples were taken under low flow conditions, there probably would have been no change in hardness.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

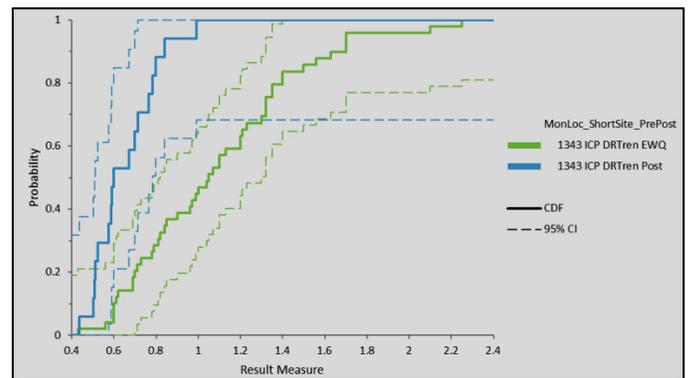
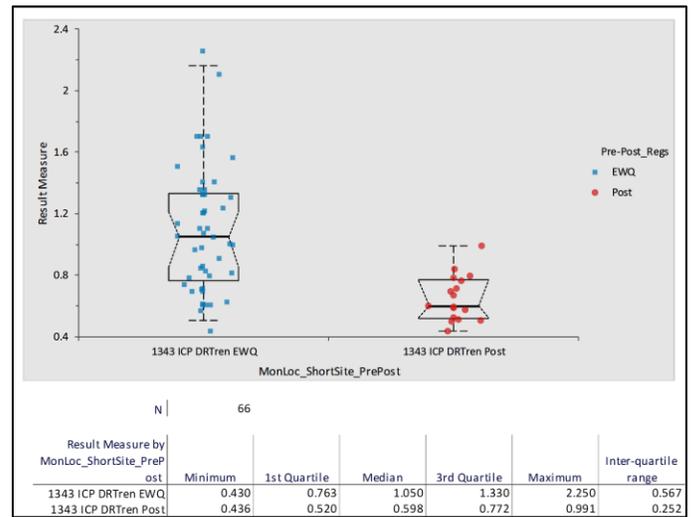
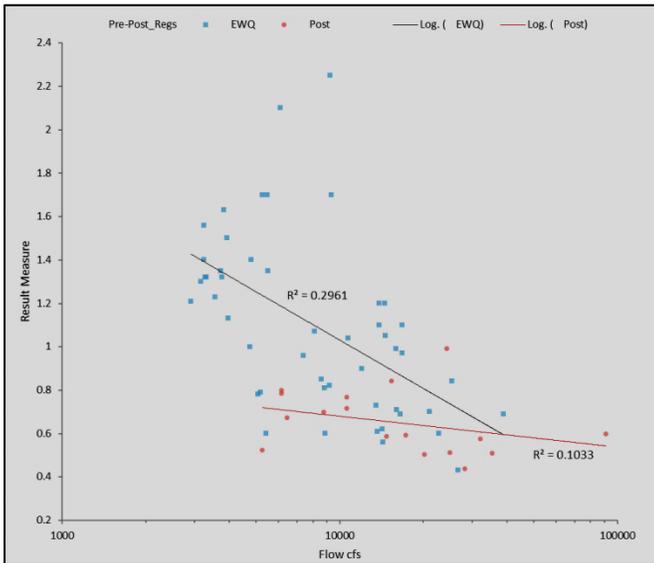
Nitrate + Nitrite as N, Total mg/l

Existing Water Quality (as Nitrate only):

Median 1.05 mg/l

Lower 95% Confidence Interval 0.85 mg/l

Upper 95% Confidence Interval 1.21 mg/l

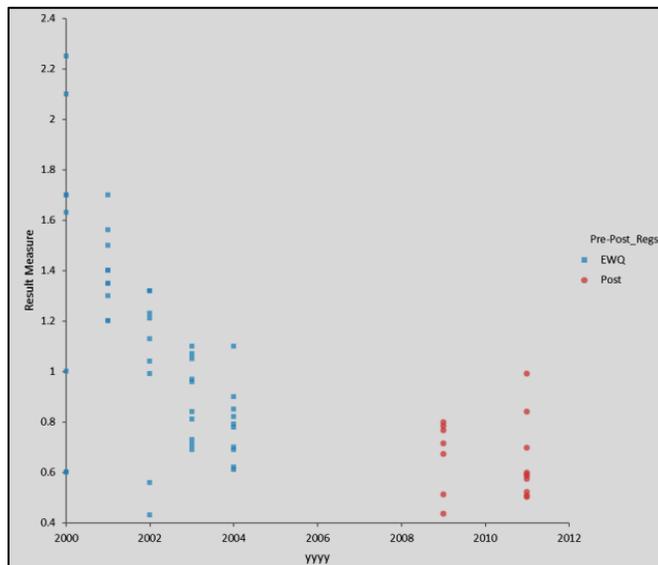


Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	49	1818.4	37.11
1343 ICP DRTren Post	17	5241.3	308.31

H statistic: 19.16  
 X² approximation: 19.16  
 DF: 1  
 p-value: <0.0001<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \dots$   
 The median of the populations are all equal.  
 H1:  $\theta_i \neq \theta_j$  for at least one i, j  
 The median of the populations are not all equal.  
<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.



No water quality degradation is indicated. Nitrate concentrations apparently declined between the EWQ and post-EWQ periods, but differences in flow, detection limits, laboratory artifacts, and low post-EWQ N produced analytical uncertainty. EWQ nitrate was inversely but weakly related to flow.

Post-EWQ nitrate + nitrite are not related to flow, though there is a single influential data point taken during flood conditions that drives the regression; as well as too few low-flow samples. 2010 samples were not taken due to bridge closure. Independent USGS and PADEP data were analyzed to validate DRBC results, but the decline could not be confirmed. Both data sets exhibited more variability in the EWQ period than the post-EWQ period. The early portion of DRBC EWQ data showed higher concentrations than both DRBC post-EWQ data and the independent data. DRBC 2003-2011 and USGS/PADEP independent data were very similar.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

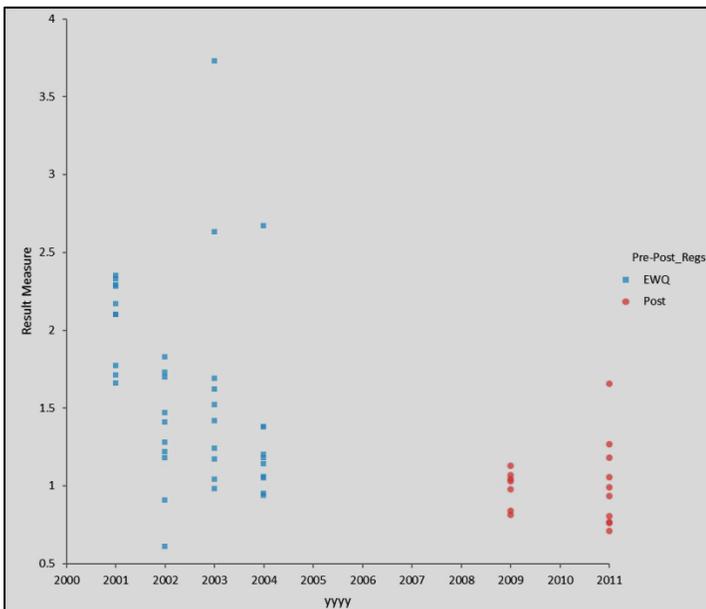
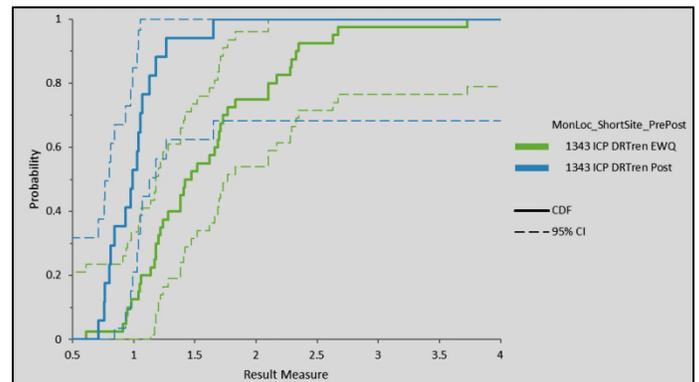
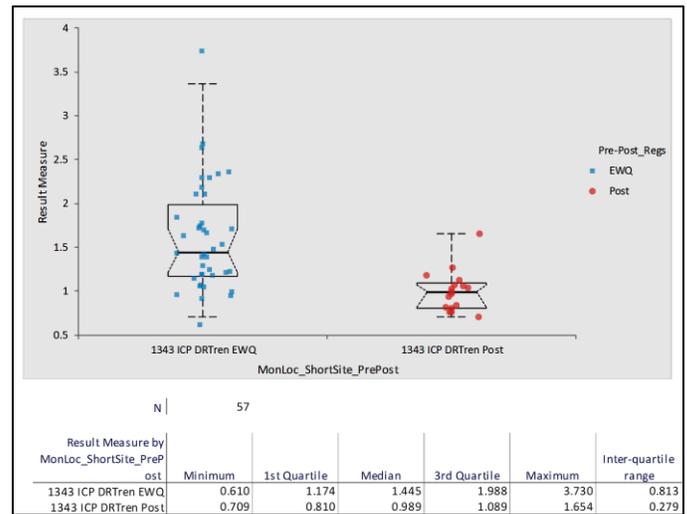
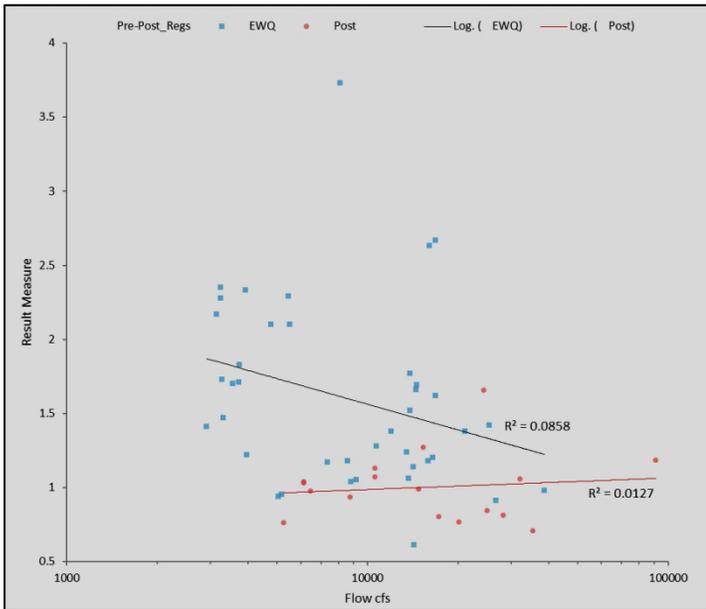
Nitrogen as N, Total (TN) mg/l

Existing Water Quality:

Median 1.45 mg/l

Lower 95% Confidence Interval 1.22 mg/l

Upper 95% Confidence Interval 1.71 mg/l



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	40	1434.0	35.85
1343 ICP DRTren Post	17	3374.1	198.48

H statistic 17.45  
 X² approximation 17.45  
 DF 1  
 p-value <0.0001<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta...$   
 The median of the populations are all equal.  
 H1:  $\theta_i \neq \theta_j$  for at least one i,j.  
 The median of the populations are not all equal.

<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

No water quality degradation is indicated. Total Nitrogen concentrations apparently declined between the EWQ and post-EWQ periods, but differences in flow, detection limits, potential laboratory artifacts, and low post-EWQ N produced analytical uncertainty. TN is unrelated to flow in both periods. The EWQ data overall are far more variable than the post-EWQ data. No 2010 samples were taken due to bridge closure. Independent PADEP and USGS data did not display the same decline, thus the DRBC results could not be independently validated.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

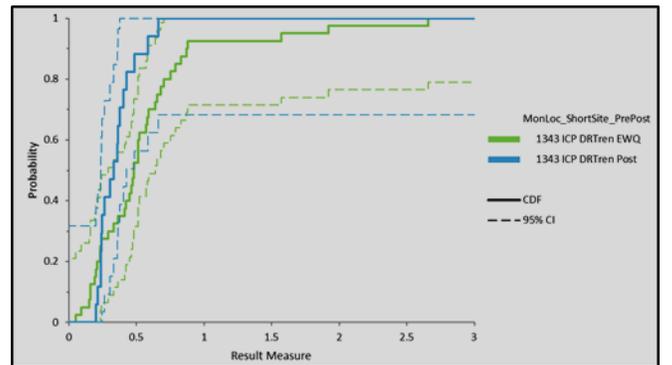
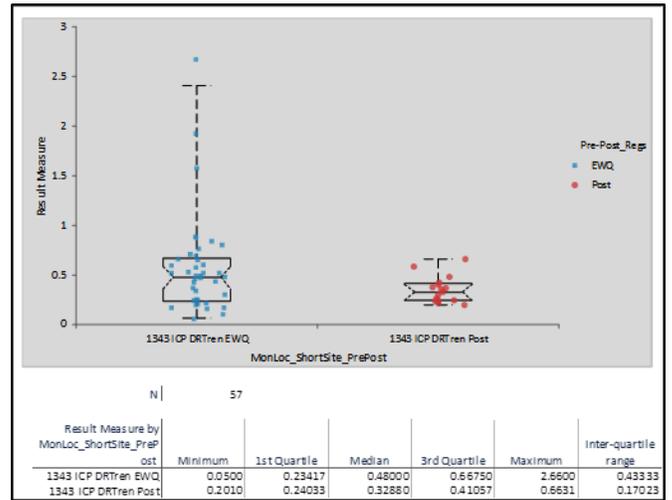
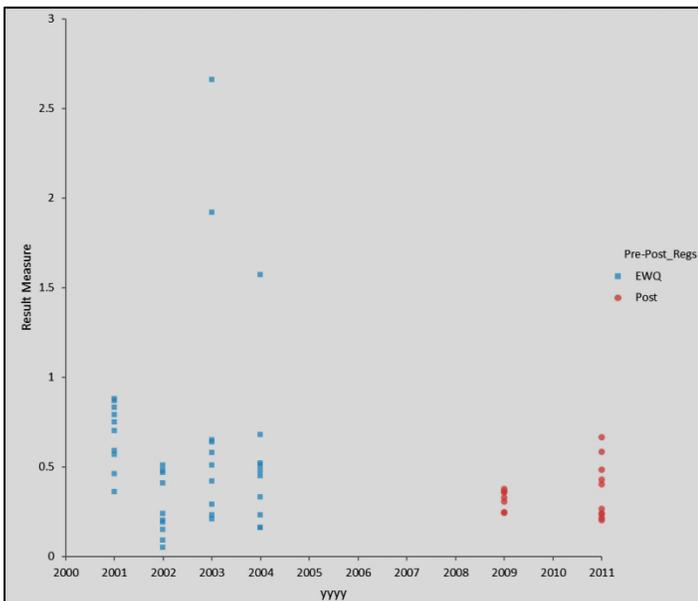
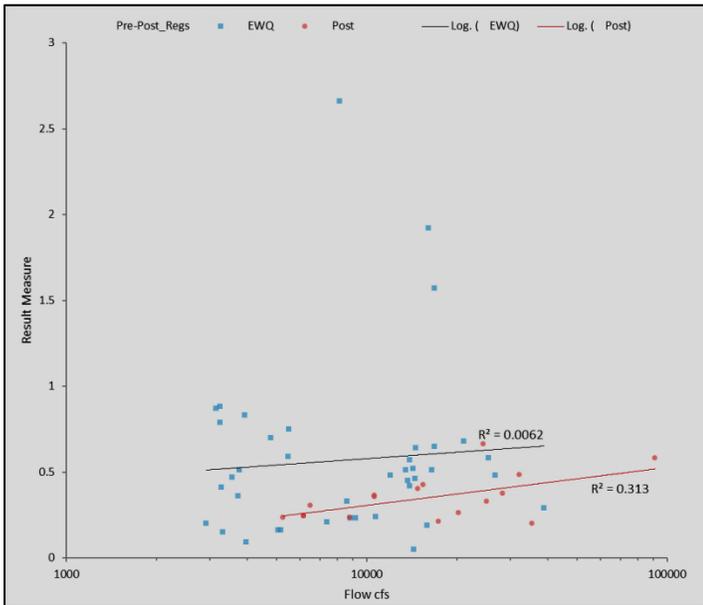
Nitrogen, Kjeldahl as N, Total (TKN) mg/l

Existing Water Quality:

Median 0.48 mg/l

Lower 95% Confidence Interval 0.36 mg/l

Upper 95% Confidence Interval 0.58 mg/l



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	40	245.0	6.13
1343 ICP DRTren Post	17	576.5	33.91

H statistic | 2.98  
 X<sup>2</sup> approximation | 2.98  
 DF | 1  
 p-value | 0.0842<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta...$   
 The median of the populations are all equal.  
 H1:  $\theta_i \neq \theta_j$  for at least one i, j  
 The median of the populations are not all equal.  
<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

No measurable change occurred in TKN concentrations between the EWQ and post-EWQ periods. Flow differences, insufficient post-EWQ sampling (n=17) and potential laboratory artifacts produced analytical uncertainty. TKN concentration is unrelated to flow in both data sets. No 2010 samples were taken due to bridge closure.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

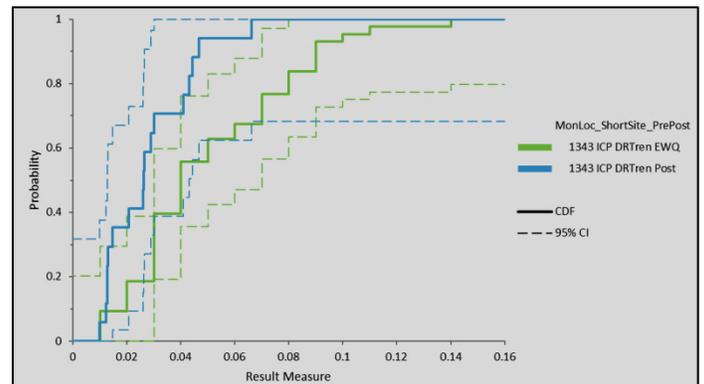
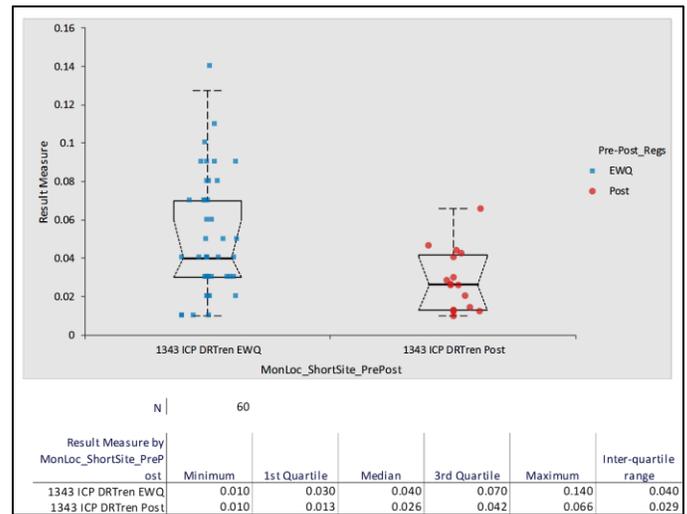
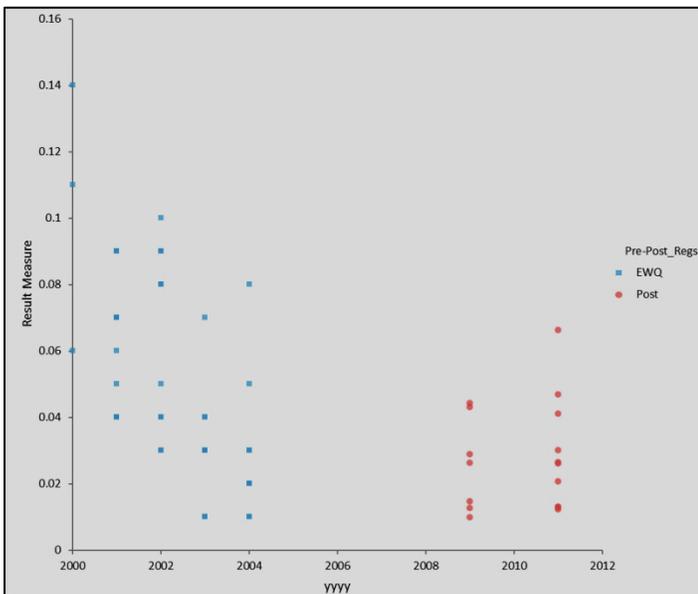
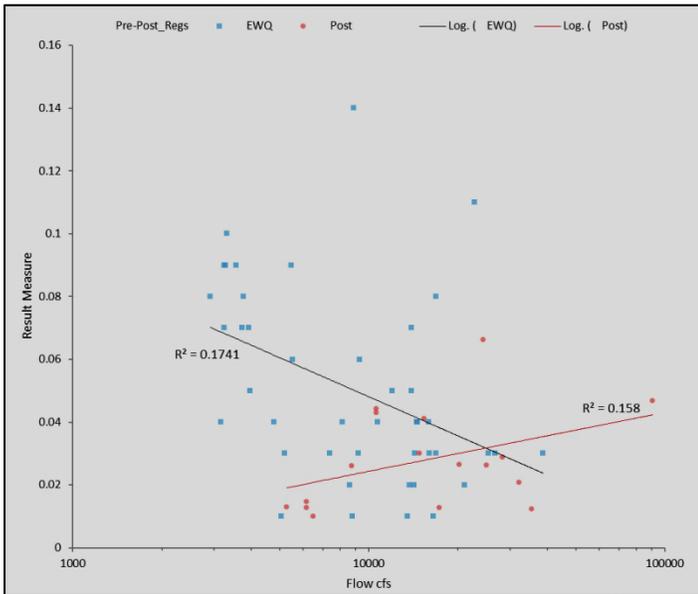
Orthophosphate as P, Total mg/l (OP)

Existing Water Quality:

Median 0.04 mg/l

Lower 95% Confidence Interval 0.03 mg/l

Upper 95% Confidence Interval 0.06 mg/l



Kruskal-Wallis test

MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	43	621.7	14.46
1343 ICP DRTren Post	17	1572.5	92.50

H statistic: 7.24  
 $\chi^2$  approximation: 7.24  
 DF: 1  
 p-value: 0.0071<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3 \dots$   
 The median of the populations are all equal.  
 H1:  $\theta_i \neq \theta_j$  for at least one i,j.  
 The median of the populations are not all equal.

<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

No water quality degradation is indicated. OP apparently declined between the two periods, though differences in flow, detection limits, and low post-EWQ N produced uncertainty. Orthophosphate is unrelated to flow in both data sets. No 2010 samples were collected at this location due to bridge closure. There were too few available independent data to confirm DRBC results, though PADEP concentrations were similar in magnitude and variability throughout both study periods. DRBC detection limits improved between the two periods, so the decline may be influenced by improved laboratory method sensitivity.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

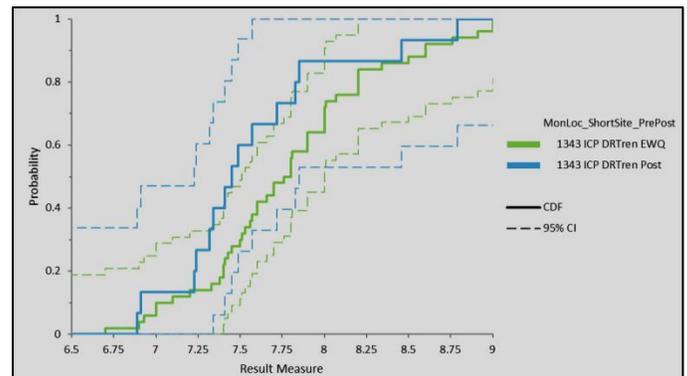
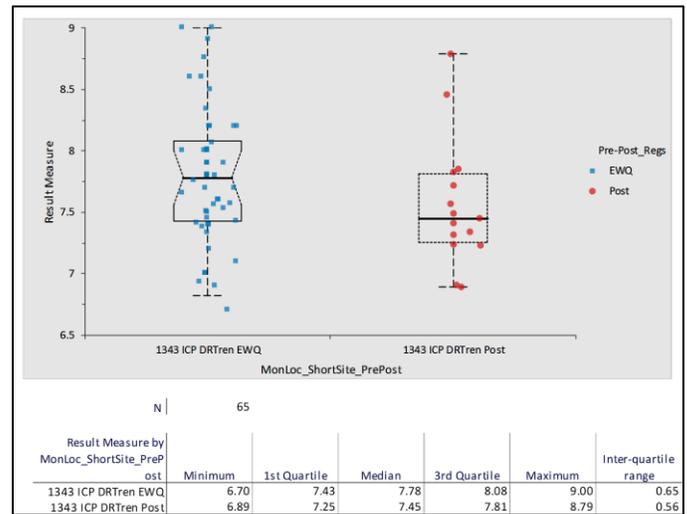
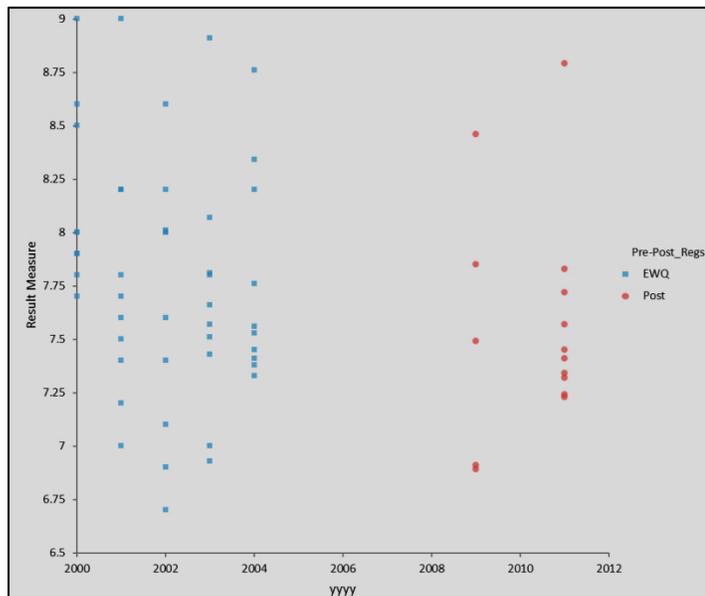
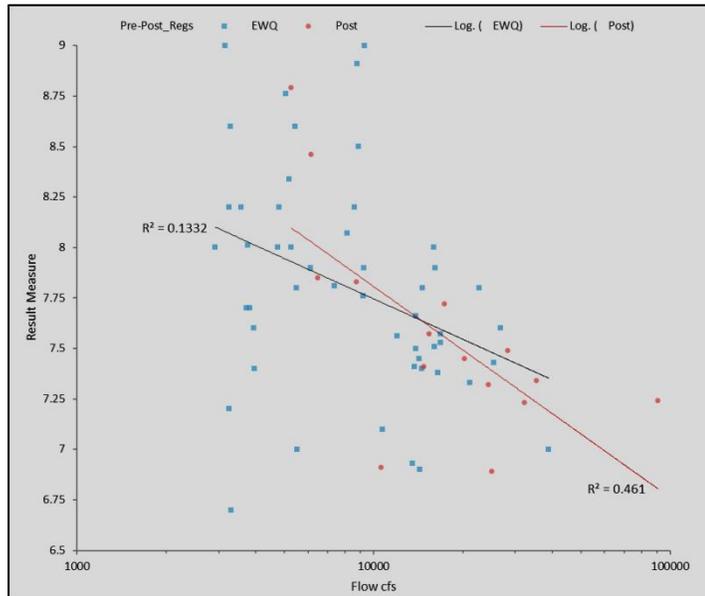
pH, units

Existing Water Quality:

Median 7.78 standard units

Lower 95% Confidence Interval 7.56 standard units

Upper 95% Confidence Interval 8.00 standard units



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	50	257.6	5.15
1343 ICP DRTren Post	15	858.8	57.25

H statistic	3.13
$\chi^2$ approximation	3.13
DF	1
p-value	0.0771 <sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3 = \dots$   
 The median of the populations are all equal.  
 H1:  $\theta_i \neq \theta_j$  for at least one i, j  
 The median of the populations are not all equal.  
<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is indicated. PH did not measurably change between the EWQ and post-EWQ periods. Under higher flow conditions, pH tends toward neutral. During low flow and high primary productivity periods, pH criteria are frequently exceeded (>9.0 units). No 2010 samples were collected at this location due to bridge closure.

PH is unrelated to flow in the EWQ data, but inversely related to flow in the post-EWQ data. Flow is plotted on a logarithmic scale.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

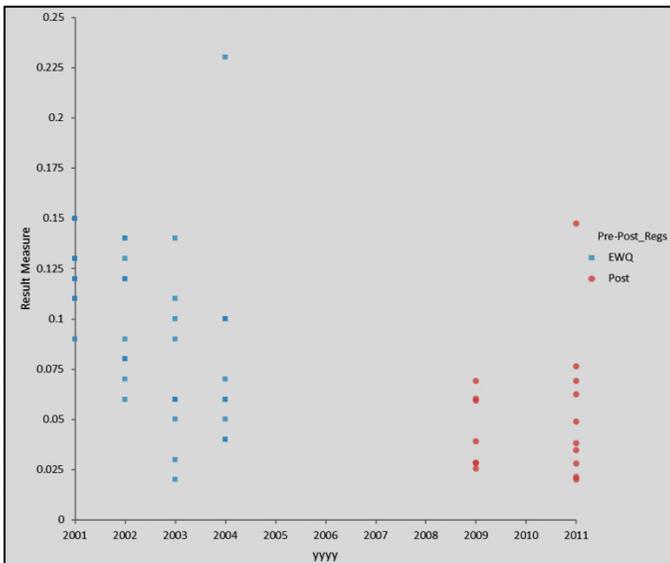
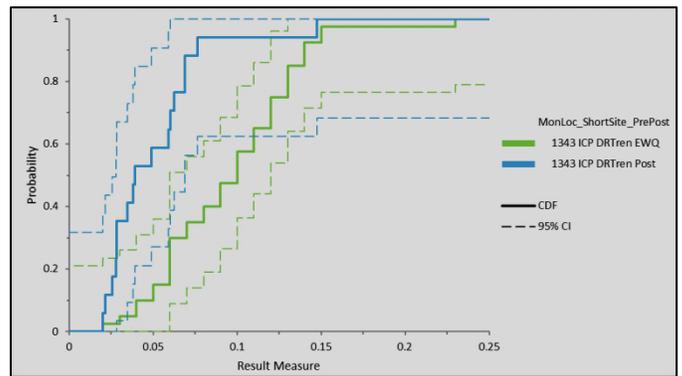
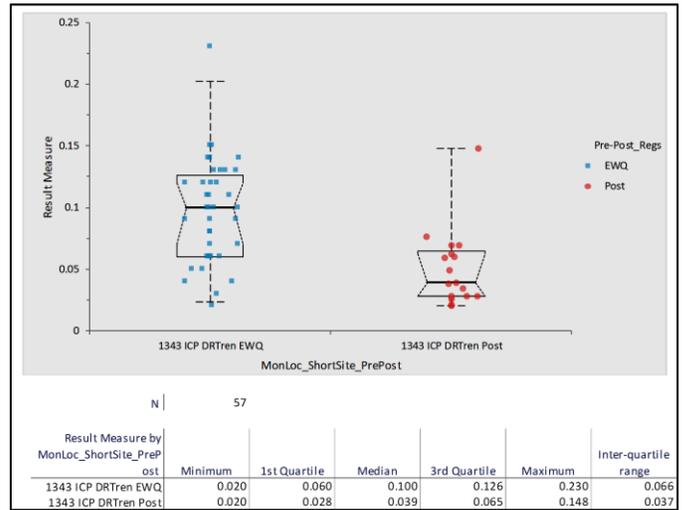
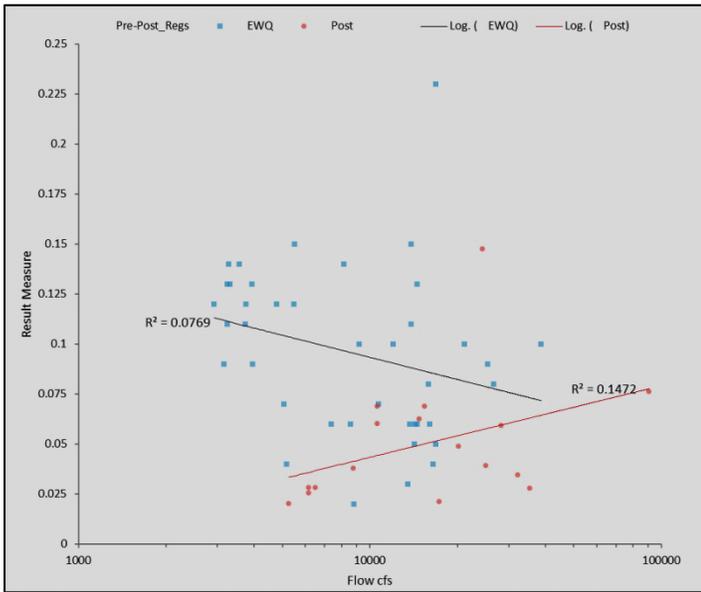
Phosphorus as P, Total (TP) mg/l

Existing Water Quality:

Median 0.10 mg/l

Lower 95% Confidence Interval 0.07 mg/l

Upper 95% Confidence Interval 0.12 mg/l



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	40	1199.0	29.98
1343 ICP DRTren Post	17	2821.2	165.96

H statistic 14.63  
 $\chi^2$  approximation 14.63  
 DF 1  
 p-value 0.0001<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3$ ...

The median of the populations are all equal.

H1:  $\theta_i \neq \theta_j$  for at least one i,j

The median of the populations are not all equal.

<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

No water quality degradation is indicated. Total Phosphorus (TP) concentrations appeared to decline significantly between the EWQ and post-EWQ periods, though differences in flow conditions, potential laboratory artifacts and low post-EWQ N produced uncertainty. TP is unrelated to flow in both data sets. No 2010 samples were taken due to bridge closure. At other sites where nutrient concentrations are lower, the decline in concentration may be partially due to improved laboratory detection limits. At Trenton, however, there were no undetected results at any time. These results could not be independently confirmed by PADEP and USGS data.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

Specific Conductance  $\mu\text{mho/cm}$

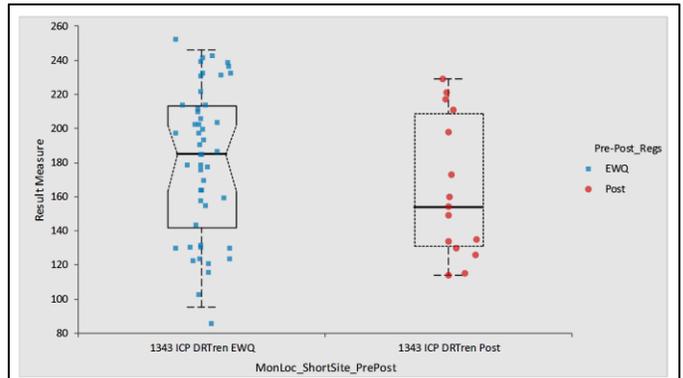
Existing Water Quality:

Median 185  $\mu\text{mho/cm}$

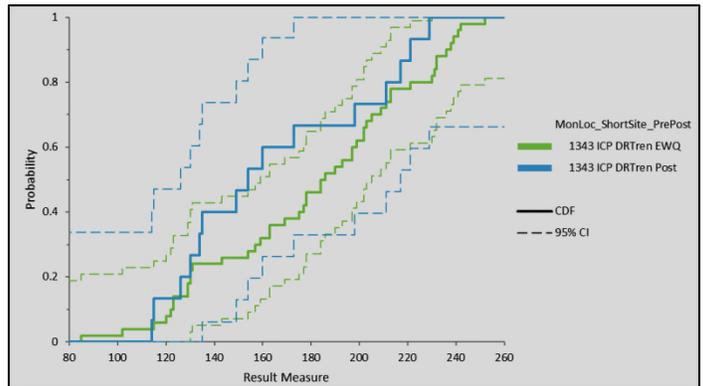
Lower 95% Confidence Interval 163  $\mu\text{mho/cm}$

Upper 95% Confidence Interval 202  $\mu\text{mho/cm}$

Defined in regulations as a flow-related parameter



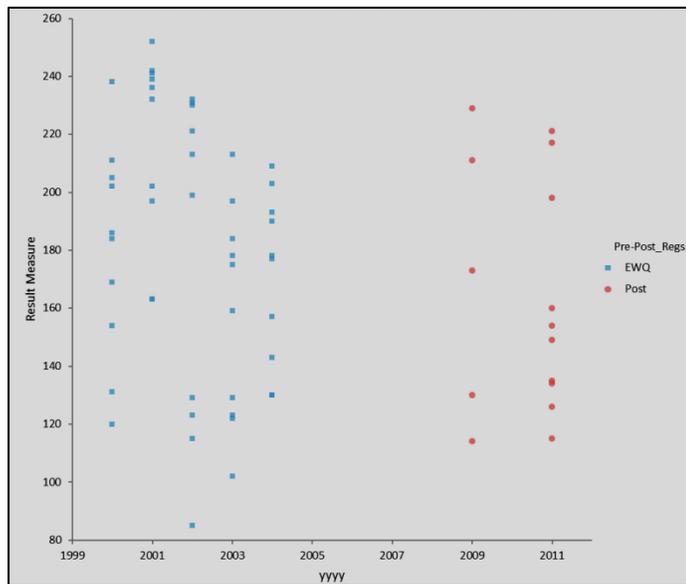
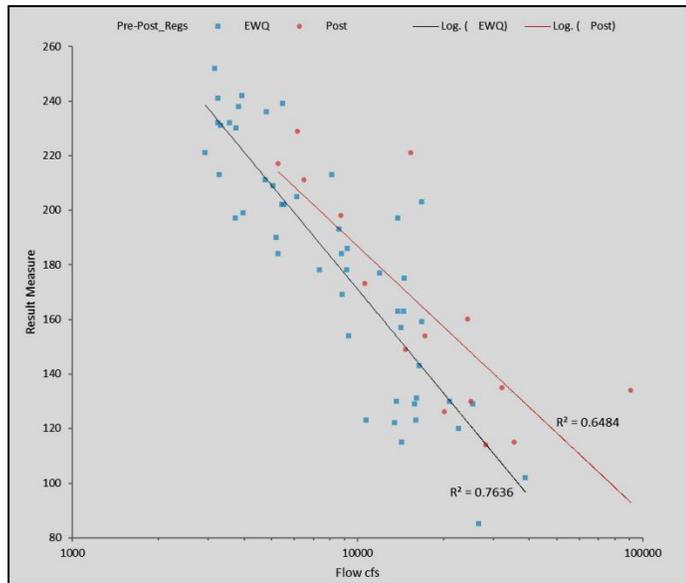
Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1343 ICP DRTren EWQ	85	142.0	185.0	213.0	252	71.0
1343 ICP DRTren Post	114	130.7	154.0	208.8	229	78.2



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	50	137.8	2.76
1343 ICP DRTren Post	15	459.3	30.62

H statistic 1.67  
 $\chi^2$  approximation 1.67  
 DF 1  
 p-value 0.1962<sup>1</sup>  
 H0:  $\theta_1 = \theta_2 = \theta_3 \dots$   
 The median of the populations are all equal.  
 H1:  $\theta_i \neq \theta_j$  for at least one i,j  
 The median of the populations are not all equal.  
<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.



No water quality degradation is indicated. Specific conductance did not measurably change between the EWQ and post-EWQ periods. In both data sets, specific conductance is inversely related to flow. In the post-EWQ data, a single outlier pulls off the slope of the regression – a consequence of too few samples taken in the post-EWQ period (n=15). The outlier was a sample taken during flood conditions. No 2010 (low-flow, dry weather) samples were taken at this location due to bridge closure.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

Total Dissolved Solids (TDS) mg/l

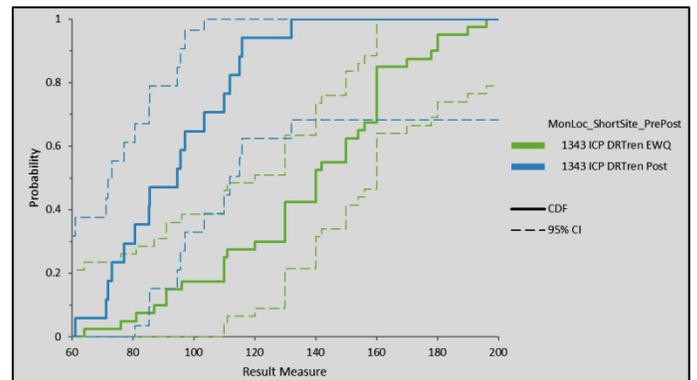
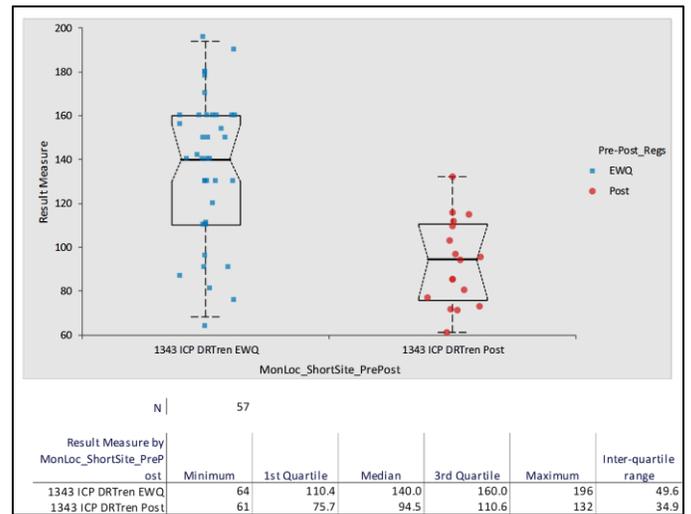
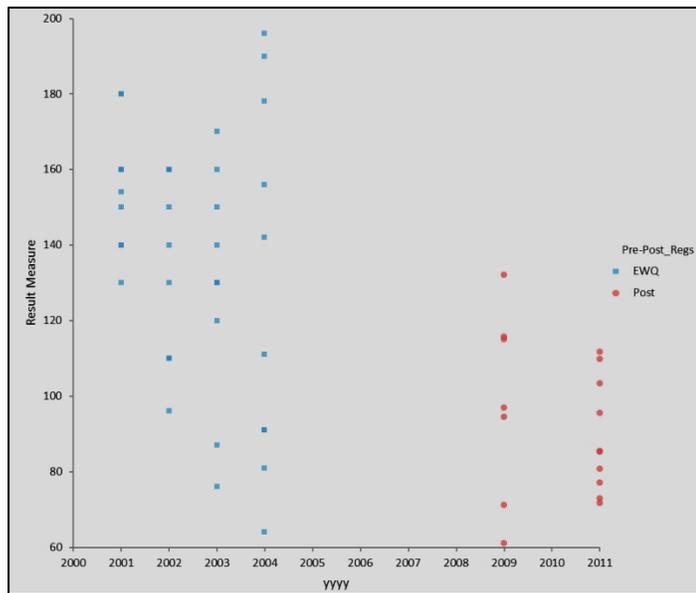
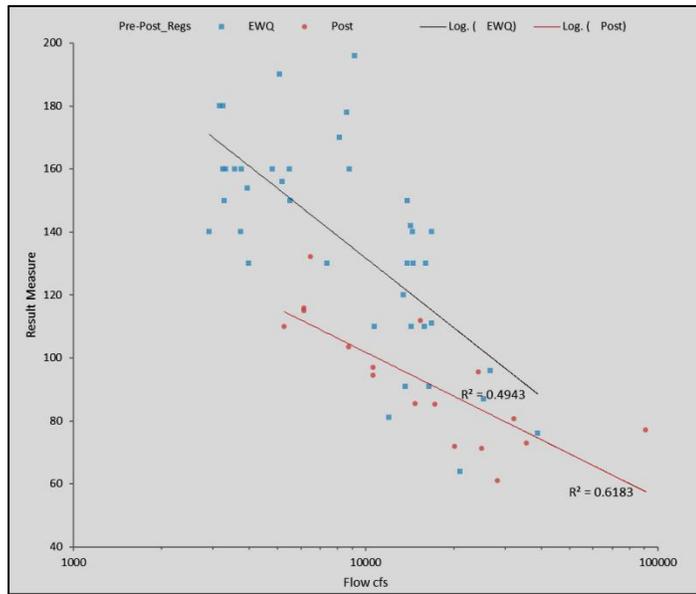
Existing Water Quality:

Median 140 mg/l

Lower 95% Confidence Interval 130 mg/l

Upper 95% Confidence Interval 156 mg/l

Defined in regulations as a flow-related parameter



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	40	1488.4	37.21
1343 ICP DRTren Post	17	3502.1	206.01

H statistic | 18.17  
 X² approximation | 18.17  
 DF | 1  
 p-value | <0.0001<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3 = \dots$

The median of the populations are all equal.

H1:  $\theta_i \neq \theta_j$  for at least one i,j

The median of the populations are not all equal.

<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

No water quality degradation is indicated. TDS appeared to measurably decline between the EWQ and post-EWQ periods. However, such a decline is uncertain because of differences in flow, potential laboratory artifacts, and too few post-EWQ samples. TDS is inversely related to flow. Since far fewer of the post-EWQ samples were low-flow samples, much of the apparent decline in TDS is probably attributed to flow effects at the time of sampling. Most samples were taken at higher flow conditions, and there were an insufficient number of samples taken under low flow conditions.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

Total Suspended Solids (TSS) mg/l

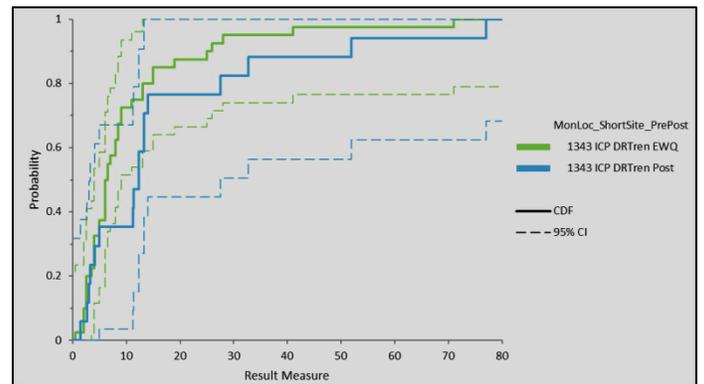
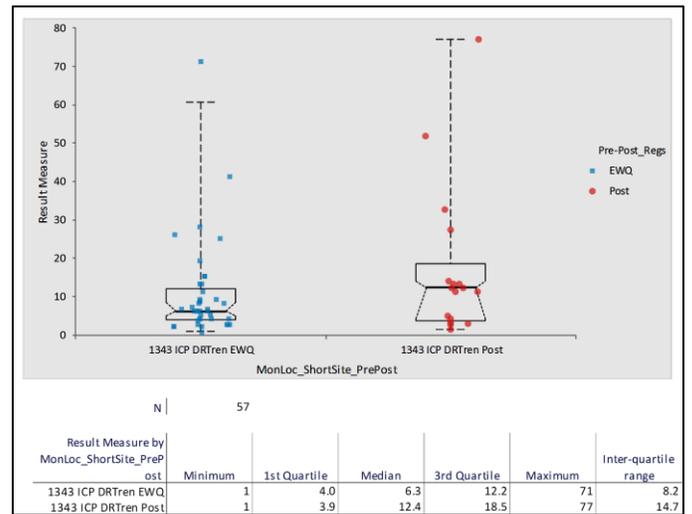
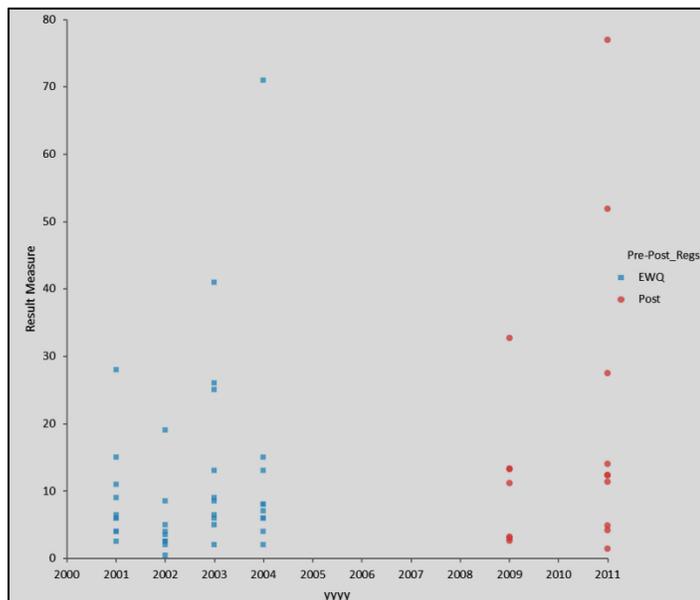
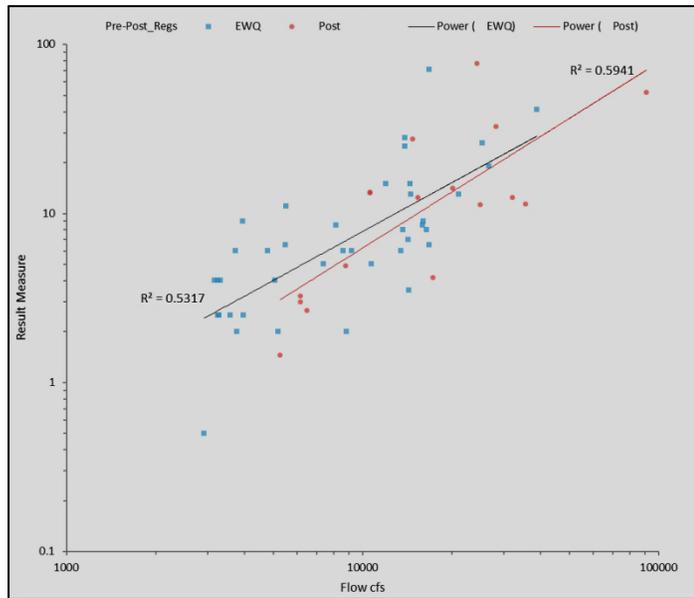
Existing Water Quality:

Median 6.3 mg/l

Lower 95% Confidence Interval 5.0 mg/l

Upper 95% Confidence Interval 8.5 mg/l

Defined in regulations as a flow-related parameter



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	40	164.0	4.10
1343 ICP DRTren Post	17	385.9	22.70

H statistic 2.00  
 X² approximation 2.00  
 DF 1  
 p-value 0.1573<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta...$   
 The median of the populations are all equal.  
 H1:  $\theta_i \neq \theta_j$  for at least one i,j.  
 The median of the populations are not all equal.  
<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is indicated. TSS did not measurably change between the EWQ and post-EWQ periods. Flow differences, insufficient post-EWQ sampling (n=17) and potential laboratory artifacts produced analytical uncertainty. TSS is positively related to flow in both data sets. No samples were taken at this location in 2010 due to bridge closure.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

Turbidity NTU

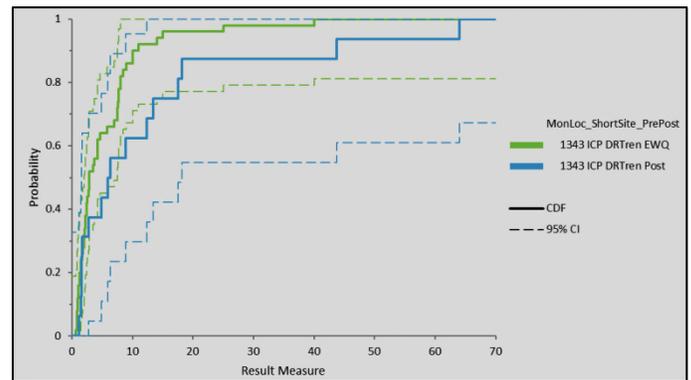
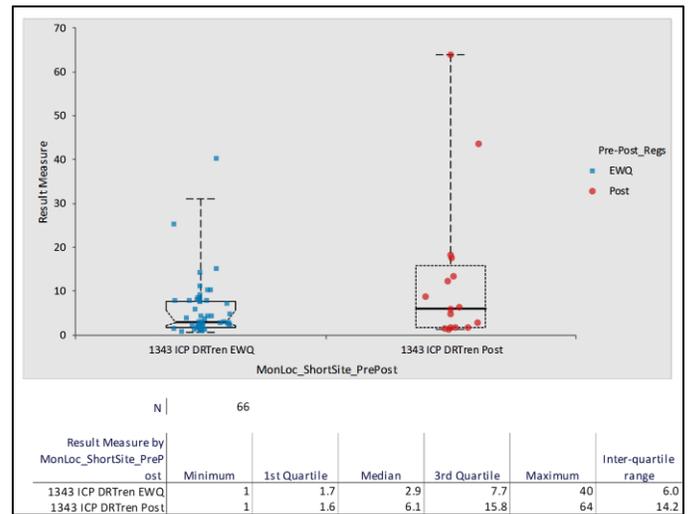
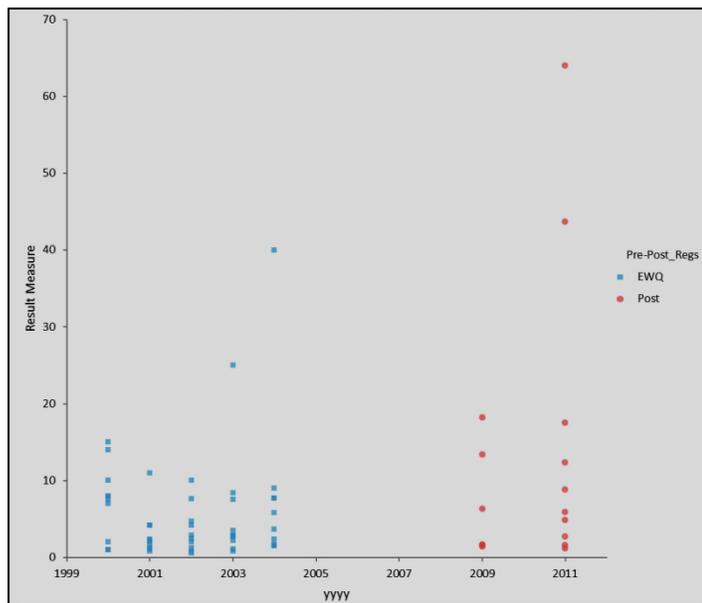
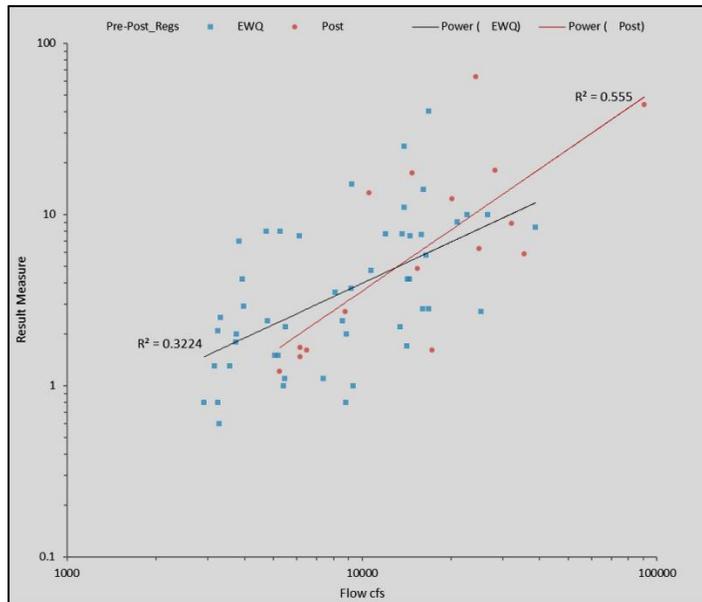
Existing Water Quality:

Median 2.9 NTU\*

Lower 95% Confidence Interval 2.2 NTU

Upper 95% Confidence Interval 5.8 NTU

\*Should have been defined as flow-related in rules



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1343 ICP DRTren EWQ	50	220.5	4.41
1343 ICP DRTren Post	16	689.1	43.07

H statistic | 2.47  
 X² approximation | 2.47  
 DF | 1  
 p-value | 0.1161<sup>1</sup>

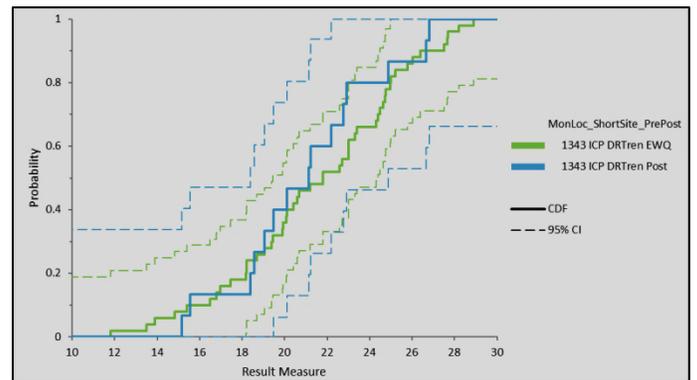
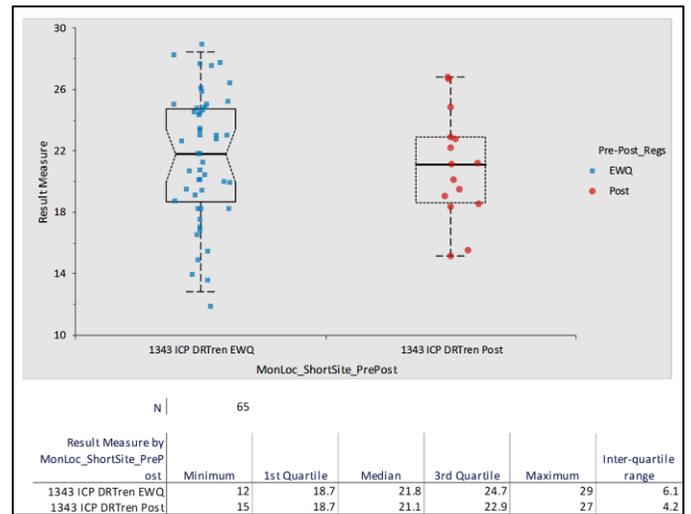
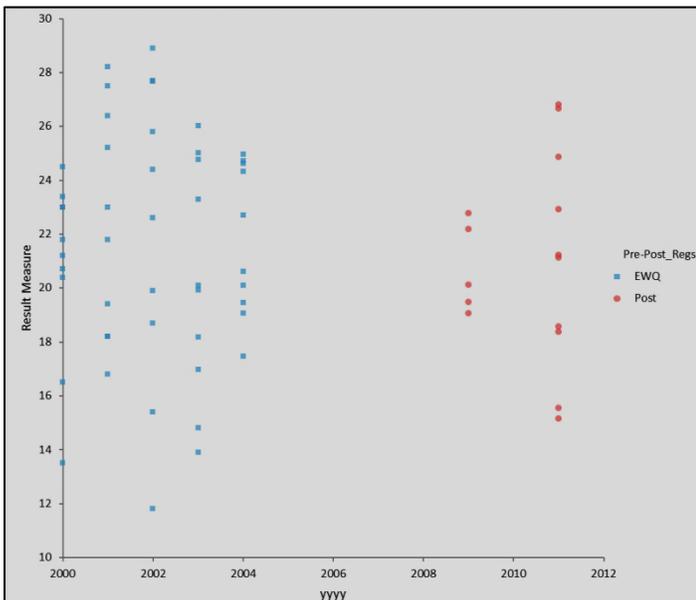
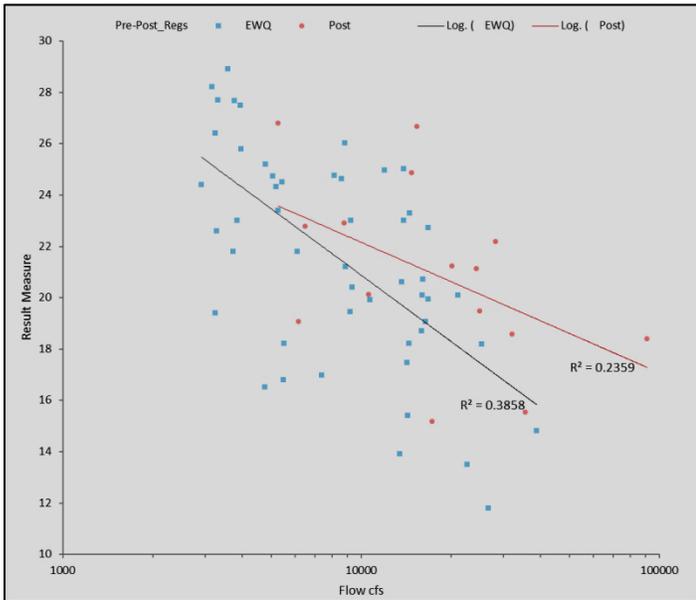
H0:  $\theta_1 = \theta_2 = \theta...$   
 The median of the populations are all equal.  
 H1:  $\theta_i \neq \theta_j$  for at least one i,j  
 The median of the populations are not all equal.  
<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is indicated. All but two post-EWQ turbidity results were within the expected EWQ range of 0-40. Both were taken during high flow conditions: one within the previously-sampled range of flows, and one far outside that range during a major flood event. Flow differences and insufficient post-EWQ sampling (n=16) produced analytical uncertainty. The post-EWQ median turbidity was above the EWQ upper 95% confidence interval, but the increase was not significant. In both data sets, the turbidity vs. flow relationship is positive. No 2010 samples were taken at this location due to bridge closure.

Chapter 1: 1343 ICP Delaware River at Trenton, NJ

Water Temperature, degrees C

Not included in DRBC Existing Water Quality rules



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost		n	Rank sum	Mean rank
1343 ICP DRTren EWQ	50	23.8	0.48	
1343 ICP DRTren Post	15	79.4	5.29	

H statistic: 0.29  
 X² approximation: 0.29  
 DF: 1  
 p-value: 0.5911<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta...$   
 The median of the populations are all equal.  
 H1:  $\theta_i \neq \theta_j$  for at least one i,j  
 The median of the populations are not all equal.  
<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is indicated. Water temperature did not measurably change between the EWQ and post-EWQ periods. Flow differences and insufficient post-EWQ sampling (n=15) produced analytical uncertainty. Water temperature is inversely related to flow, though the relationship is weak. No samples were taken in 2010 at this location due to bridge closure.